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# Measuring Progress of Estuary Programs

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## Committee Members

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## **Summary**

Estuaries are a major national resource and economic asset over and beyond their importance as food sources and recreational areas. The United States has approximately 100 estuaries. Protecting them is a vital concern to the nation. Organizations in many of these estuaries have established programs aimed at their protection. The U.S. Environmental Protection Agency's (EPA) National Estuary Program (NEP) currently has 21 participating estuaries.

This manual provides a series of suggestions on how estuary programs, localities, states, and the federal government (each of which have major interests in estuary protection) can regularly track the progress that estuary protection programs are making. The focus is on identifying the outcomes and results of estuary protection efforts that can be useful to estuary managers and other officials. This manual is not addressed to the technical community; it does not cover procedures directly related to the highly technical details involved in environmental monitoring.

By participating in the NEP, estuaries have agreed to organize their efforts around the development and implementation of a Comprehensive Conservation and Management Plan (CCMP). This agreement spells out the threats to the estuary and the plan for improving the protection of the estuary and its waters. The outcome monitoring procedures outlined in this manual should be useful in the development of CCMPs as well as in their implementation. The material presented is based to a considerable extent on pilot efforts undertaken by the NEPs in Buzzards Bay (Massachusetts) and Tampa Bay (Florida) over an 18-

month period in 1992 and 1993. The Buzzards Bay Project had completed its CCMP and was in the implementation phase during the pilot effort. The Tampa Bay NEP was developing its CCMP during the pilot period.

This manual first discusses the basic features of an outcome measurement system and the outcome indicators that appear relevant for estuary programs. An illustrative set of indicators is included. A major characteristic of many of the suggested indicators is that they identify indicators that should be considered "intermediate" outcomes. These intermediate indicators typically indicate some action or behavior undertaken by persons or organizations that can affect bay quality but do not measure the end results (such as the condition of living resources in the bay). Procedures are described for tracking progress from estuary protection actions undertaken by: (a) governments; (b) businesses (such as those using hazardous materials); (c) households; and (d) boaters. Procedures are also presented for translating information on actual bay quality into "Bay Quality Indices" (BQI) developed from such information as available environmental monitoring data and data on beach closures to shellfishing and swimming.

Each of these procedures enables estuary officials not only to obtain the aggregate data for each outcome indicator, but also to break out the outcome data by various key characteristics. For example, changes in estuary protection activities of businesses can be broken out by type of business and by the type and amount of training and technical assistance the business received. Changes in behavior of households can be identified by county or town and household composition. Changes in the BQI can be broken out, for example, by segment of the bay.

The manual discusses for each procedure, and for the procedures as a whole, their limitations and cost implications. Finally, it presents suggestions on how the information from the various procedures might be analyzed and presented to estuary officials and the public in the most useful way.

## Forward

Since the National Estuary Program (NEP) was created in the 1987 amendments to the Clean Water Act (CWA), EPA has identified 21 estuaries across the nation, including Puerto Rico, as nationally significant estuaries. Programs for each of these 21 estuaries have been working hard to bring all the public and private stakeholders together to develop a plan for the long-term protection and management of their estuarine resources. These plans, known as Comprehensive Conservation and Management Plans (CCMP), identify estuary program goals and objectives and recommend actions to achieve those goals and objectives. Everyone involved invests significant time and resources to the development of the CCMP, and the public has a right to know if these efforts are making a difference and if the program is accomplishing its stated goals and objectives. To ensure estuary program managers make some effort to track their progress, the CWA requires each estuary program to monitor the effectiveness of actions taken once the CCMP is completed and to report biennially to EPA on the progress being made in the program.

As stewards of the public's estuarine resources it is our duty to keep our public informed of our efforts,

our successes, and our lessons learned. As program managers, it is also our responsibility to determine whether we are achieving our stated goals and objectives and adjust our actions and resource allocations as appropriate. In the field of ecosystem management, we realize there can be a long lag time between the time actions are initiated and environmental improvements achieved. As a result, it is even more important to keep our public informed of our efforts and help them to understand the reasons environmental improvements are not immediate. With these objectives in mind, the Oceans and Coastal Protection Division (OCPD) of the U.S. Environmental Protection Agency (EPA) entered into an agreement with the Urban Institute to develop procedures for use by estuary program managers interested in assessing their program's progress and using that information to report back to their public and to modify their activities as needed.

Although we do not anticipate being able to statistically aggregate results from individual estuary programs using these procedures, we do anticipate being able to conduct trend analyses based on the data from individual programs. To the extent that such trend analyses are possible, the procedures in this manual may help EPA meet the requirements of the Government Performance and Results Act (GPRA) of 1993. The GPRA asks all federal agencies to link inputs, outputs, and outcomes of their programs to improve government planning, budgeting, performance and results overall. In fact, these procedures may be found applicable to any number of other ecosystem and watershed management programs, thereby helping the EPA meet the requirements of the GPRA for programs other than the NEP. By better understanding the effectiveness of our actions, those of us dedicated to public service in environmental protection and resource management will be better able to manage our programs and resources and educate and involve our citizenry in our efforts to protect our nation's precious estuarine resources.

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# Measuring Progress of Estuary Programs

## Executive Summary

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### HIGHLIGHTS

The roughly 100 estuaries in this country are a major national resource and economic asset and their protection is a vital national concern. Organizations in many of these estuaries have established programs aimed at their protection. Twenty-one estuaries now participate in the U.S. [Environmental Protection Agency's](#) National Estuary Program.

The 1990s have become the decade of "accountability." Federal and state governments have been required by legislation to monitor and report on program results or progress. Common sense dictates that estuary protection officials regularly track the results or progress of their efforts at improving and maintaining the quality of estuary waters. To the extent that many estuary programs use similar procedures for assessing their progress, such information can also provide a national perspective on progress in estuary protection.

This report is a companion document to "Measuring Progress of Estuary Programs: A Manual" and provides a summary of how to develop and implement such an outcome monitoring process. Specifically, we examine procedures for regularly tracking progress of estuary protection efforts undertaken by governments, businesses, households, and boaters. We also present procedures for translating information on actual bay quality into a "Bay Quality Index" developed from available data on environmental monitoring and other sources such as closures to shellfishing and swimming. Estuary program officials need information to help determine where improvements are needed and whether improvement efforts have led to desired results. Such information will increase the accountability of estuary protection programs to elected officials and the public, help develop and justify budget requests, and help communicate to citizens and the media the progress being made.

Monitoring the status of an estuary is a complex undertaking. Measuring water and living resource quality at all times, in all locations, and at all depths is infeasible. However, a desire for perfection and

scientific precision should not deter the use of outcome indicators and data collection procedures that provide "roughly right" information. We emphasize that, for estuary program officials, partial knowledge about progress is better than no knowledge.

The material presented here is based to a large extent on pilot efforts undertaken by the National Estuary Programs in Buzzards Bay, Massachusetts and in Tampa Bay, Florida in 1992 and 1993. The outcome monitoring procedures described were developed over a 14-month period by Urban Institute staff and personnel from both estuaries.

For estuaries participating in the National Estuary Program, the required Comprehensive Conservation and Management Plan defines the purpose and component parts of the estuary protection program and the aims of monitoring its programs. Other estuaries likely have, or will have, a management plan to which the monitoring system described in the manual can be related.

Below, a discussion of how to identify meaningful outcome indicators is presented, and we set forth a way to track progress of estuary protection efforts of governments, businesses, households, and boaters. We then suggest how to analyze and report the outcome data collected, and caution readers about the limitations of the outcome monitoring process outlined in this report.

## **IDENTIFYING MEANINGFUL OUTCOME INDICATORS**

The word "outcome" is used throughout the manual to refer to an action or occurrence that happens outside the estuary protection program but that is likely to have occurred at least in part because of an estuary protection activity. When designing an outcome monitoring process, the first step is to identify outcome indicators, being careful to divide them into intermediate and end outcomes. Intermediate indicators typically mark some action or behavior undertaken by persons or organizations that can affect bay quality but do not represent the end results, such as the condition of living resources in the bay. As shown in the chart below, which maps the estuary protection chain of events, four categories or orders of outcome indicators are especially relevant to estuary protection activities.

Information about the change in behavior on the part of governments, businesses, households, and boaters can be obtained through the Government Action Checklist and the business, household, and boater surveys described below. Data on the health of living resources the extent to which the health of fish, other wildlife, habitat, and vegetation has changed are of particular concern to the public because they indicate whether or not the estuary can support individual uses such as swimming and shellfishing.

The table on the following page presents an illustrative set of outcome indicators that estuary protection officials can use to measure progress in estuary protection efforts.

## **TRACKING THE ACTIONS OF GOVERNMENTS: THE GOVERNMENT ACTION CHECKLIST**

The Government Action Checklist (GAC) is a vehicle for annually monitoring the overall progress that local governments are making in their efforts to protect an estuary. The Tampa Bay National Estuary Program (NEP) is using the GAC process to develop a schedule for its Comprehensive Conservation and Management Plan (CCMP); having already completed its CCMP, the Buzzards Bay Project is using the GAC process to help measure progress in meeting the goals of the CCMP.

There are six basic steps to formulating a Government Action Checklist:

1. Select the items to be assessed, that is, the set of activities that governments should undertake to maintain and improve the estuarine environment. Then group the items by useful categories of protection.

For instance, the Buzzards Bay Project used these categories:

- Nitrogen Action Plan,
- Protecting and Enhancing Shellfish Resources,
- Controlling Stormwater Runoff,
- Managing Sewage From Boats,
- Managing On-Site Wastewater Disposal Systems,
- Preventing Oil Pollution,
- Protecting Wetlands and Coastal Habitat,
- Planning for a Shifting Shoreline,
- Managing Sewage Treatment Facilities,
- Reducing Toxic Pollution,
- Conducting Pollution Remediation Projects in New Bedford.

The Tampa Bay NEP used these categories:

- Water Quality,
- Land Use,
- Septic Systems,
- Municipal Waste,
- Hazardous Materials and Hazardous Wastes,
- Stormwater,
- Conservation Measures,
- Boater Use and Boater Discharges,
- Oil Pollution and Emergency Response,
- Agricultural Industry,
- Other Industry,
- Shellfishing,
- Public Information/Technical Assistance,
- Intergovernmental Coordination,



- Miscellaneous.

2. Determine which communities will be included in the regular GAC assessments, that is, which local governments and at what level (city, county, etc.). For example, the Tampa Bay decided to start with three major counties and three large cities, recognizing that some counties encompassed as many as 22 municipalities a number thought to be unwieldy for the GAC process. Moreover, many of the counties were thought to have small impacts on bay quality. A number of the items on the Tampa Bay GAC refer to county-level activities that are not applicable to the towns. In contrast, the Buzzards Bay Project has targeted GAC monitoring for each of the communities that were signatories to the CCMP. The procedure currently covers 12 local governments. The Coalition for Buzzards Bay developed three versions of the GAC: one for coastal towns, one for inland towns, and a separate checklist for New Bedford the only large city in the local area and its industrial manufacturing hub.
3. Operationally define checklist items for assessment purposes, and develop a rating scale for each item that captures whether local governments have achieved the intended activity/action (e.g., achieved fully, partially, or not at all).
4. Select the organization that will administer the ratings and develop the summary reports. The organization should be one that is perceived as being reasonably objective by the governments being rated and by the public. A regional council of governments, planning association, or university are probably appropriate.
5. Pilot test the assessment procedures. Rarely will the first version of the GAC survive unmodified as it undergoes a pilot test among selected local communities.
6. Determine the data analysis process and reporting formats.

## **TRACKING THE ESTUARY PROTECTION BEHAVIOR OF BUSINESSES**

Businesses and industries, including agriculture, are often major contributors of pollutants to an estuary. Thus, they provide major opportunities for pollutant reduction. Progress in encouraging business and industry to adjust their operations in order to produce less hazardous polluting materials should be tracked, as should the actual magnitude of pollutants emitted.

Three ways to track progress in business-related estuary protection efforts include monitoring the data on pollutant loadings, conducting periodic surveys of businesses concerning their efforts to reduce hazardous waste, and by using a Government Action Checklist looking at the extent to which local governments urge businesses to use alternatives to hazardous materials, sponsor industrial pre-treatment programs, and implement agriculture pesticide/fertilizer best management practice (BMP) programs. Before conducting a survey of businesses, estuary program officials need to resolve the following questions: Which businesses should be included? Which geographic areas should be covered? What topics should the surveys cover? Should local business groups be asked to help shape the questionnaire? Should different versions of the questionnaire go out to different types of businesses? Should the questionnaire be administered in person, by phone, or by mail? How many businesses should be

surveyed and how can a high response rate be ensured?

Questionnaires should be short, accompanied by a letter introducing the purpose of the survey, and should not be unduly complex or intrusive. Response rates can be increased by preceding the questionnaire with a substantial educational effort. The sample questionnaire below was adapted from one prepared by the Buzzards Bay Project/Urban Institute team after much research and input from EPA staff and local officials.

## **TRACKING THE ENVIRONMENTAL BEHAVIOR OF HOUSEHOLDS AND BOATERS**

Households and boaters play major roles in estuary protection. Their actions can hurt or help the estuary's condition. Households affect estuary quality by their use of fertilizers and pesticides, disposal of contaminants such as paint and cleaning materials, and upkeep of private septic systems. Boaters affect estuary quality by dumping waste, mishandling fuel, and damaging submerged aquatic vegetation with their propellers.

Improvements in behavior can be expected to lead to reduced amounts of contaminants discharged into the waters of the estuary and subsequently to improved water quality and life conditions for animals and vegetation. The best way to assess the status of, and changes in, household and boater estuary protection behavior is to survey them periodically about their environmental protection-related activities.

When examining changes in household and boater behavior from year to year, small observed differences are not likely to be as important to estuary program officials as large differences. This means that large household and boater samples yielding a high degree of precision are not likely to be needed.

### **How to Conduct Household Surveys About Environmental Behavior**

1. Prepare questionnaire to be administered to households and consider hiring a local survey organization to conduct the survey. Pre-test the questionnaire on a small number of households or boaters representing a cross-section of households to whom the questionnaire will be administered. In its household survey, Tampa the Bay NEP sought information on household composition, whether respondents owned or rented their homes, county of residence, and whether respondents lived in an apartment, condominium, or mobile home as distinct from a house in order to exclude that group for questions relating to lawn fertilizers, pesticides, materials used for walk areas, and so on.
2. Identify appropriate listings of the household population and draw a random sample of households;
3. Consider ways to increase survey completion rates. These include keeping the questionnaire or telephone interview short, designing a user-friendly questionnaire, attaching a cover letter to the questionnaire that explains its purpose and is signed by a community person with favorable name

recognition, using second and third mailings as well as follow-up phone calls, and offering an incentive such as a free publication for completing and returning the questionnaire.

4. Administer questionnaire by a combination of mail and telephone;
5. Track returns and carry out a second mailing or phone call to non-respondents about three weeks after the first mailing;
6. Conduct telephone reminders or phone interviews to non-respondents in order to achieve the targeted response rate (we suggest 50 percent);
7. Tabulate responses;
8. Prepare report on findings, including both the numerical results and a summary of the main findings. An illustrative report format for household survey responses, using hypothetical data appears on the following page.

An example of how the Tampa Bay NEP summarized its main household survey findings appears on the following page. This format can also be used for reporting the findings of the business survey.

## **DEVELOPING A BAY QUALITY INDEX**

The purpose of a Bay Quality Index (BQI) is to provide a sound, reliable composite indicator of an estuary's overall health. The index should be clear and useful to public and private officials and to the public at large. It should permit the monitoring of trends in estuary quality over time, help identify aspects of bay quality that need extra attention, and enhance the ability of estuary program officials to communicate needs and progress to citizens and the media. A BQI is not intended as a scientific tool but as a management and policymaking tool.

Federal and state governments are already using a variety of environmental indices. For example, the State of Ohio has developed an "Index of Biotic Integrity." This uses data on the number of different types of species and the total number of species to produce an overall biological assessment of the quality of streams. The Hillsborough County Environmental Protection Commission in Florida has been annually updating a water quality index. It was used as a starting point for both the Buzzards Bay Project and Tampa Bay NEP to develop their Bay Quality Indices. The Hillsborough index also serves as a model for some of the procedures discussed in this report.

A BQI is likely to receive special attention from the media because of its apparent simplicity, just as overall air pollution indices in cities have achieved considerable acceptance by the media, the public, and even the technical community.

Four steps are needed to develop a BQI:

1. Select the components to include in the index. Examples of components for a BQI focusing on condition of living resources are presented on the following page.
2. Determine the way in which these components are to be combined into the index. This involves transforming the values for each component into a common unit of measurement, combining

these normalized values into an overall index value, and applying "weighting factors" that reflect each parameter's importance as an indicator of the health of the bay. The respective weights can then be multiplied by each of the "normalized" values of the BQI components and added together to produce the latest value of the BQI. The weights used in the Hillsborough County index are as follows:

3. Identify those values of the index that represent the various levels of bay quality such as excellent, good, fair, or poor.
4. Select the sub-indices likely to be useful. These include sub-indices for various geographic segments of the estuary and for groups of components such as living resources, support of desired uses of the bay, and water quality. While an overall index for the estuary is of interest to elected officials and the public, the sub-indices and individual environmental indicators are more useful to government and private sector personnel. The exhibit on the next page illustrates an attractive way to report geographical information. Such a map can also include data on sub-indices such as the condition of fish and support for desired uses.

## **Cost**

Environmental monitoring can be very expensive for a local program. Estuary programs will need to concentrate scarce resources on those index components, locations, and times that represent key "pressure points" for the estuary.

The ultimate test for determining the worth of the time and cost required is whether estuary protection personnel are able to use the information to help them more effectively allocate resources for estuary protection and to communicate bay quality outcomes to the public.

## **ANALYZING AND REPORTING OUTCOME DATA**

Outcome data that have taken time, effort, and resources to collect are useless unless appropriately analyzed and effectively presented. In the Manual we suggest specific ways to analyze and report the findings from each data collection effort described the Government Action Checklist, and the business, household, and boater surveys. Estuary protection programs will want to combine the data obtained from these efforts by using a format like the one shown below, and compare the findings from the various outcome indicators against the goals identified in the estuary program's long-range plan.

A "Summary of Survey Findings," similar in format to the summaries recommended for each separate data collection effort and drawn from those summaries, should do two things. It should report the extent to which targets set by the estuary program have been achieved during the current reporting period, and it should compare the outcome information for the current reporting period to that for the previous period(s).

Estuary program and community officials will likely find the outcome information more useful if

the Summary of Survey Findings is accompanied by explanatory information to help identify factors believed to have contributed significantly to the main findings.

## CAVEATS

Readers should be aware of several limitations to the outcome monitoring process outlined in the Manual. These are listed below.

- **Lack of Causal Information.** Outcome data provide a "scorecard" but do not generally provide a sound basis for praising or criticizing estuary protection activities. Outcome information is vital for understanding what has been happening and what progress is being made, and for helping to identify where future attention and resources are needed. But to obtain information on why the outcomes are as they are, or why changes over the last reporting period have occurred, estuary personnel will need to conduct more in-depth examinations.
- **The Need for Periodic Outcome Information.** One year of information will serve as baseline data for comparisons for future years. But it will be of somewhat limited value by itself in identifying trends, unless the estuary program has been fortunate enough to have prior-year data on outcome indicators.
- **The Delayed Effects of Program Actions.** Some estuary protection actions cannot be expected to lead to quick, substantive changes. For example, major problems caused by the presence of toxins or excessive nitrogen may take years to correct. Both the source of the problem as well as accumulated damages must be corrected.
- **Cost.** Establishing an outcome monitoring process requires staff time and time on the part of many advisory groups representing citizens, technical experts, and special interests in the community. However, once the procedures become routine, the effort required should be reduced considerably.

Implementing an outcome monitoring process is hard work and is not something that an estuary program can do overnight. It will minimally take a year to establish such a process, and probably two to three years to fully implement it. Estuary protection, however, is a long-run proposition. Doing it well requires continuous, long-term attention.

Ultimately, an outcome monitoring process needs to stand the test of cost-effectiveness. If the information is not used to help estuary program officials improve their work, or if it does not provide funders or the public with relevant information that they can understand and utilize, the results will not be worth the costs. It is therefore imperative that estuary program staff design and implement an outcome monitoring process with great care, keeping in mind at all times that the purpose of the endeavor is to provide officials and the public with clear and meaningful information that they can use to improve estuary protection.



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# Measuring Progress of Estuary Programs

## Introduction

[The Purpose of Regular Outcome Measurement](#)

[Coverage and Scope](#)

[The Basis for these Proceedings](#)

[Developing Estuary Protection Outcome Monitoring Procedures](#)

[Limitations of Outcome Monitoring](#)

[The Need for Cost and Staff Effort To Be Kept Low](#)

[Organization of this Manual](#)

This manual identifies outcome indicators and describes procedures that individual estuary protection programs can use to track progress in protecting their estuaries. The focus of the procedures is on obtaining regular information on the *outcomes* of estuary protection activities. The word "outcome" is used throughout this manual to refer to an action or occurrence that happens *outside* the estuary protection program but that is likely to have occurred at least in part because of an estuary protection activity. Outcomes do not include measures of the quantity of program work activity. The definition of outcome used in this manual intentionally does not include the requirement that the outcomes measured are the result of estuary protection activity. As discussed later, such causality is usually difficult to determine because of the many other factors that can contribute to outcomes.

The 1990s have become the decade of "accountability," "managing-by-results," and "customer satisfaction." Federal and state governments have been required by legislation (such as the Government Performance and Results Act of 1993) and by the National Performance Review and Total Quality Management systems now in place, to monitor and report on program outcomes or results.

The widely disseminated publications of authors such as Thomas Peters and Robert Waterman, W. Edwards Deming, David Osborne and Ted Gaebler, and Peter Drucker have argued for what seems to be pure common sense: publicly supported programs should regularly, or at least annually, track the *results* and outcomes of their efforts. What does this mean for estuary protection programs? Common sense dictates that estuary protection programs should regularly track the outcomes of their efforts at improving and maintaining the quality of estuary waters. Estuary protection officials should use this information to

help them determine where improvements are needed and, later, whether improvement efforts have led to targeted or desired results.

Monitoring the status of an estuary is a complex undertaking. Measuring water and living resource quality at all times, in all locations, and at all depths would be prohibitively expensive. No estuary would attempt that, even if it could afford to do so. But estuary programs need a process that provides adequate and appropriate information so that judgments can be made about the estuary's health.

Estuary managers and the public need meaningful information in order to judge progress in protecting and regenerating the nation's estuaries. The objective of an outcome monitoring system is to provide information that can help managers measure both progress in estuary protection and significant changes to an estuary over time. Such information can also set the stage for relating observed changes to their possible causes. To do this, estuary officials need to track progress in actions taken by governments, industries, and households, and to track environmental indicators of water quality and the health of estuary living resources.

For estuaries participating in the NEP, the required Comprehensive Conservation and Management Plan (CCMP) defines the purpose of the estuary protection program and a planned monitoring process. Other estuaries likely have, or will have, a management plan to which the outcome tracking system described in this manual can be related. Some estuary programs may be in the process of developing an estuary protection plan such as a CCMP. If they are already undertaking estuary protection projects (such as providing encouragement to citizens to take steps to reduce polluting-related behavior), they probably can use at least some of the procedures in this manual to track the outcomes of their efforts. Even estuary programs not yet undertaking any "action" projects can review these procedures to glean suggestions for progress tracking procedures and to develop baseline data against which to compare later progress.

The outcome monitoring procedures described here were developed with the participation of two estuaries that are part of the NEP: the Buzzards Bay Project in Massachusetts and the Tampa Bay NEP in Florida.

Both programs established project advisory committees to provide guidance to their work. These committees comprised representatives from local governments, citizen groups, and the technical community. In addition, local NEP staff used special advisory groups for some of the new monitoring procedures, such as the development of a Government Action Checklist and a Bay Quality Index, both of which are described below.

This manual also benefited from a national advisory group that provided early guidance on the elements the project team should examine and on the draft final report.

An important consideration for outcome monitoring procedures is that they be affordable. We have incorporated many components where data are likely to be already available or new low-cost procedures, such as use of volunteers to help with surveys, are likely to be readily achievable.

This manual presents an illustrative set of outcome indicators that estuary programs can consider for their own use. We describe in detail four data collection procedures that can provide data on a number of these outcome indicators and that are not commonly applied to estuary programs. Each of these procedures can generate outcome information on a regular basis. These procedures include:

1. Use of a Government Action Checklist to track progress in local public agency actions (a similar type of checklist is needed covering state and federal activities);
2. Surveys of business and industry to track their behavior in environmental protection, such as hazardous waste reduction;
3. Surveys of households and boaters to track their behavior with respect to wastes; and
4. Development of a Bay Quality Index to track overall water quality and health of the bay's living resources.

## **PURPOSE OF REGULAR OUTCOME MEASUREMENT**

Regularly monitoring the outcomes of estuary protection efforts has the following basic purposes:

- To help estuary program officials and managers plan, manage, and improve estuary protection programs. Outcome information obtained by tracking the extent of progress being made should help them improve program activities, identify new activities that are needed, and set priorities by identifying where existing activities are achieving or not achieving desired results, and by identifying problem areas;
- To increase accountability of estuary protection programs to elected officials and the public, so they can assess the extent to which desired results were achieved after resources were applied;
- To help develop and justify budget requests, especially when outcome information is linked to proposed resources and activities;
- To communicate to citizens and the media the progress being made.

Other more specific estuary program uses include the following:

- If an estuary program sets targets for itself each year, the outcome assessments can be used to track progress in meeting these targets.
- The information from the process can be used to provide baseline information for estuary programs that engage in long-range/strategic planning.
- For programs that incorporate a "total quality management" (TQM) approach, the outcome information should provide an important part of TQM's measurement requirements.
- The outcome information can help identify activities that need more in-depth evaluation, such as activities that are not generating the outcomes expected. The availability of past outcome information should also enable in-depth studies, such as evaluations of particular estuary protection activities, to be conducted more efficiently and expeditiously by providing relevant data for these studies.
- The procedures should be useful to estuary officials during the early years of an estuary



protection program, such as during the period leading up to final Comprehensive Conservation and Management Plan approval:

- During the CCMP preparation period, estuary programs undertake numerous activities intended to help protect the estuary even though the CCMP has not been completed. For example, estuary programs carry out various efforts to alert their citizens to estuary protection needs and undertake demonstration projects. Outcome monitoring procedures such as those described here can help the estuary protection program track the achievements of those efforts.
  - For estuary programs preparing strategic plans such as CCMPs, the outcome monitoring process can also help form the basis for the estuary program's CCMP monitoring plan, as required under CWA Section 320(b)(6).
  - The Government Action Checklist process (described in Section 4) can be used, as in the Tampa Bay NEP, to help identify the specific steps needed to protect the estuary over the long run steps that should be included in the CCMP.
  - As noted earlier, the initial data collected by the procedures will provide the baseline against which progress can be measured.
- At any stage, whether pre- or post-CCMP, the outcome indicators can be used to help track progress on major special projects and activities. This can be done if the relevant outcome indicators are broken out to relate to the project, for instance, by breaking out the outcome data by the specific geographical areas or types of households or businesses targeted by the project. If, for example, an estuary program has a special project to provide on-site technical assistance to businesses in a particular industry for hazardous waste reduction, the program can obtain separate tabulations of indicators of changes in industry behavior for the particular businesses directly assisted. The program could also compare the outcome data for assisted businesses to those for businesses that did not receive such assistance.
  - The "ordering" of the indicators into sequential stages (as described in Section 2) can be used to help estuary officials and the public understand the time and steps necessary for achieving environmental results. This can lead to more realistic expectations and greater public support over the long run.

The information generated by outcome monitoring is also intended to help federal and state officials in their accountability and program improvement tasks. For example, the federal government can use the information provided by individual estuary programs to help prepare reports to Congress on the progress and achievements that have occurred. The federal government can also use the information from many locations to identify what performance areas have been weakest and need technical assistance or other help. Since each estuary program will likely have somewhat different outcome indicators and measurement procedures, the quantitative values will usually not be additive. Other aggregated forms of the outcome information, however, can be used.

The procedures in this manual are *not* aimed at tracking internal activities, such as the number of committee meetings held or other "activity" measures, though such information may be desirable

for a variety of estuary internal management purposes.

For national purposes, to the extent that many estuary programs use similar procedures, such information can be accumulated and reported to provide a *national* perspective on progress in estuary protection. With over 100 estuaries around the nation, estuary protection is a major resource concern to the country as a whole.

## COVERAGE AND SCOPE

This manual presents an illustrative set of basic indicators of estuary protection outcomes and describes procedures that can be used by estuary protection programs to obtain regular (quarterly or annual) data on these indicators. The manual also includes illustrative data collection instruments such as questionnaires that can be adapted for use by individual estuary programs. Estimates are provided of costs and the extent to which an estuary program is likely to need special resources to utilize these procedures.

The manual also suggests the steps that estuary programs can take to develop *their own version* of the outcome indicators and data collection procedures.

The procedures described in this manual track progress in the following categories of estuary protection activities:

- Progress of individual *governments* in implementing estuary protection actions and activities;
- Progress in encouraging key *industries* to alter their practices and to reduce their release of polluting substances;
- Progress in encouraging *households and boaters* to undertake actions that reduce potential estuary pollution and damage;
- Finally, and ultimately the most important, progress in achieving overall improved water quality, improved condition of living resources, and increased ability of the estuary to support desired public and business uses of the estuary waters.

This manual does not describe technical procedures for obtaining detailed environmental monitoring data or for obtaining more commonly collected information needed for outcome measurement, such as effluent data and extent of shellfish closures. As indicated later, such procedures are needed for a comprehensive outcome monitoring process but are likely to be already familiar to estuary programs.

## BASIS FOR THESE PROCEDURES

The Urban Institute examined numerous materials relating to performance indicators and held

numerous interviews with EPA and estuary protection personnel. Two estuary programs participated as pilots and helped develop and test these outcome monitoring procedures: the Buzzards Bay Project in Massachusetts, which had recently completed development of its CCMP, and the Tampa Bay NEP in Florida, which was just beginning its program and has not yet completed its CCMP. NEP personnel from each of these two estuaries, together with the Urban Institute team, worked over 14 months to identify appropriate indicators of estuary protection outcomes and low-cost data collection procedures.

The procedures reported here have been tested by one, and sometimes both, estuary programs, or are in the final stages of testing as of this writing.

The principal tests conducted include the following:

- Both estuary programs are undertaking tests or have completed pilot tests of the "Government Action Checklist" procedures. The joint estuary program-Urban Institute team worked with public officials, citizen groups, and other professionals in each estuary to develop a checklist of government actions that the officials believe are important for governments to implement. Procedures for assessing the extent to which each item on the checklist has been achieved by each local community were developed. (In the Buzzards Bay Project, the progress ratings are being assessed by an existing citizen group, the Coalition for the Buzzards Bay Project. In the Tampa Bay NEP, the assessments are being conducted by the Regional Planning Council). Repeating this process annually will provide officials and the public with an indication of progress over time. The information generated is also expected to be used by the individual communities to help them identify gaps that need to be filled.
- The Tampa Bay NEP conducted a test of a random sample of households throughout the area and, separately, a survey of households in two neighborhoods whose residents were given special guidance in ways households can protect estuary waters. In both surveys, the purpose was to assess the level of current household estuary or environmental protection behavior and the extent to which activities being conducted by the estuary program have achieved results, and to provide baselines for measuring progress in future years when the surveys are repeated.
- The Buzzards Bay Project tested a survey of boaters to identify the extent to which boaters are properly handling wastes. Periodic surveys will indicate progress achieved after efforts have been made to inform boaters on recommended waste-handling procedures.
- The Buzzards Bay Project undertook an initial test of a survey of industries that use or generate hazardous/toxic waste. The purpose is to provide a baseline for future periodic surveys, to help ascertain technical assistance needed by participating businesses, and to help identify whether and to what extent programs to reduce hazardous waste (and to

improve waste handling) are achieving desired results.

- Both sites developed and tested procedures to develop Bay Quality Indices. The indices combine key available indicators of water quality, condition of living resources such as fish and shellfish, and the ability of the waters to support public and business uses such as shellfishing and swimming. These indices can also be broken out by major sections of the estuary. Such indices are based on available data and do not necessarily represent the ideal composition of such indices, but do reflect the practical cost limitations on data collection. A key feature is that the indices are understandable to public officials and the public.

## **DEVELOPING ESTUARY PROTECTION OUTCOME MONITORING PROCEDURES**

The outcome indicators and data collection procedures presented in this manual are intended to illustrate what individual estuary programs can do in their own outcome monitoring efforts. The indicators and procedures are not intended to be copied verbatim. Each estuary program will want to develop its own version of such procedures, though some basic elements are likely to be common to most, if not all, estuaries. The outcome indicators and data collection procedures identified here can also be used as starting points for estuaries that are not already monitoring the outcomes of their estuary protection programs. Estuaries with existing outcome monitoring procedures may find some suggestions contained here useful for improving their efforts.

We recommend that estuary programs use these outcome indicators and data collection procedures as a starting point to identify which indicators and procedures are appropriate for their own estuary. For example, what items should be included in your own Government Action Checklist? Which topics should be covered by your own household and industry survey instruments? Which elements are practical for inclusion in your own Bay Quality Index?

The process for developing outcome monitoring procedures should involve existing local policy, management, and citizen advisory committees to help identify the overall set of outcome indicators and the various data collection procedures. The sections of this manual that describe each procedure also describe a process that a local estuary program can use to develop its own version of those procedures.

## **LIMITATIONS OF OUTCOME MONITORING**

Outcome information tells public officials the status of each outcome indicator, but does not tell what caused the outcomes. This limitation should be recognized by all those using outcome information. We also emphasize, however, that having regular information on outcomes is a basic first step toward directing attention to aspects of environmental protection that need attention and later indicating whether past activities have led to desired outcomes. In some instances, the

estuary program will be able to identify *likely* linkages between actions taken and outcomes, such as when special effort has been applied to particularly problems at particular locations *and* improvements in those problems subsequently occur at those locations.

A useful analogy is that of sports activities. A baseball or football score is needed to tell whether the team is winning or losing but does not tell why. Outcome information provides a scorecard for estuary protection program information vitally important for managing and overseeing activities, but does not tell the reasons for good or bad outcomes. More information is needed, perhaps a special study, to indicate why.

External factors can, and often do, play a major role in determining outcomes. For example, unusual amounts of rain, or start up of new businesses, can have considerable effect on water quality. Sometimes we simply don't know on a scientific basis whether action "A" led to outcome "A." A new waste treatment plant coming on line just prior to observed improvements in the nitrate levels in an estuary may have had little or no causal relationship to the improved nitrate levels. Declining nitrate levels might be the result of improved farm management practices or a reduction in the size of farms, rather than the result of a new treatment plant. Nor will outcome information by itself identify *what should be done* to correct problems indicated by the outcome information. Nor will these procedures by themselves provide estimates of the *efficiency* with which program resources are being used. However, when combined with other information such as program costs these procedures will support estimates of the cost-effectiveness of program activities. Lag times between cause and effect often can obscure the linkage or may lead observers to the wrong conclusions. Linkages, attribution, lag times, and many other considerations may be involved in judging performance of any one set of actors or actions in the improvement or decline in the state of an estuary. (These problems apply less to the "intermediate" outcome indicators suggested throughout this manual; the activities of estuary programs can much more directly affect intermediate outcomes see discussion in the next section.) Thus, users of outcome information such as that described in this manual should not rely solely on the outcome data for drawing conclusions about the reasons and causes for the observed outcomes. Expectations must be tempered with a realistic understanding of the complexities of cause and effect.

## **THE NEED FOR COST AND STAFF EFFORT TO BE KEPT LOW**

Some of the data needed for outcome monitoring should already be readily available in many, if not most estuaries (such as estimates of effluents, beach closures to shellfishing, and some environmental monitoring data). In such cases, little or no added cost is likely to be required to use that data for tracking outcomes. The new procedures described in this manual, however, each require additional staff time and cost. Formal estuary protection programs such as the NEP are seldom, if ever, the sole data collection organization for an estuary. The outcome measurement work should be coordinated with, and use relevant data from, other federal, state, local, and private organizations.

To reduce costs, surveys of households or organizations can use mail survey procedures if ample follow-ups of non-respondents are used to obtain reasonably credible response rates. Random samples can also be used to reduce collection costs, rather than attempting to survey all households or all organizations. Mailing costs are likely to be small, but the administration of surveys requires staff time to process the mailings, do the tabulations, and prepare the reports. Clerical staff and, perhaps, volunteers can be used on these activities, making such surveys feasible, even for small estuary protection programs.

The cost of regular Bay Quality Index preparation depends on how much data collection is done regularly on the various components of the Bay Quality Index. An ideal Bay Quality Index would likely require major resources for regular collection of a large number of often complex water quality and living resource condition measurements. The use of volunteers to collect and compile some data elements (as is done by the Buzzards Bay Project and other estuary programs) will increase the feasibility of obtaining data on some index components for those estuary programs with limited resources. Because estuary programs need to collect data on environmental indicators, most of the cost of the collection will need to be incurred whether or not the estuary implements an outcome monitoring process. Thus, the principal added costs of calculating Bay Quality Indices should be small.

Cost issues are discussed in more detail in each of the chapters that describe the data collection procedures.

## ORGANIZATION OF THIS MANUAL

This manual has eight sections. In [Section 2](#) we suggest how to identify useful outcome indicators, grouping estuary indicators into four "orders" that fit well with the monitoring format used in the Comprehensive Conservation and Management Plans for NEPs. In [Section 3](#) we identify an *illustrative set of performance indicators* based on those generated by the Buzzards Bay Project, the Tampa Bay NEP, and Urban Institute personnel after extensive discussions with local experts and officials. Hundreds of indicators were suggested in first-round discussions. The resulting list was whittled down from that initial master list.

In [Section 4](#) we present the process for tracking the *actions of governments* the local Government Action Checklists used by both pilot estuaries. We include recommendations on how to present this information to the public and to local officials.

[Section 5](#) contains recommendations on obtaining information on *protection practices of the business sector*, including use of surveys of businesses on hazardous and toxic waste reduction based on work conducted by the Buzzards Bay Project. We present the rationale for these surveys, the procedures used, and the questionnaire.

In [Section 6](#) we describe procedures for obtaining information about *protection practices of households and boaters*. Using the household surveys conducted in the Tampa Bay NEP and the boaters survey conducted in the Buzzards Bay Project, we present the rationales, procedures, and simple data collection instruments.

In [Section 7](#) we present recommendations for *Bay Quality Indices* based on those being used in both pilot estuaries. We highlight the use of citizen volunteers and the existence of measurement problems.

In [Section 8](#) we suggest *ways to analyze and report the outcome information* gathered from the various data collection procedures in order to provide useful and useable information for estuary program officials.

#### **Notes, Section 1**

**1. The Office of Water is in the process of identifying environmental indicators, in order to track progress and report results to the public in meeting Agency goals. See appendix 5 for recommended indicators.**

**2. The CBP has developed a similar approach to measuring progress. Appendix 6 provides a brief description of their efforts.**



Note: This information is provided for reference purposes only. Although the information provided here was accurate and current when first created, it is now outdated.

# Measuring Progress of Estuary Programs

## Identifying Useful Outcome Indicators and Implementing an Outcome Monitoring System

In this section we examine how to categorize outcome indicators and outline the basic steps in implementing an outcome monitoring system.

[Categorizing Outcome Indicators](#)

[Cost and Effort Required for Outcome Monitoring](#)

[Final Comments on Overall Procedures](#)

## Categorizing Outcome Indicators

The first step in categorizing outcome indicators is to *distinguish indicators of outcomes from those that measure the quantity of work activity done*. Counting the number of meetings held by estuary program staff or the number of water quality readings taken are indicators of work activity. These numbers are important to estuary managers, but say nothing about the results of those activities.

Here we define an outcome indicator as an indicator that measures responses that have occurred *outside* the program, such as changes in the estuary protection behavior of the public or businesses, reduction in the amount of pollutants released into the bay, changes in the condition of life in the bay, and so on.

The next step is to distinguish *end outcome indicators from intermediate outcome indicators*. Estuary protection programs generally aim to affect the behavior of governments, businesses, households, and boaters. Improved environmental behavior actions by these groups are important outcomes, but are not the ultimate ends being sought. Instead, they represent intermediate outcomes. Examples of end outcome indicators are improved bay quality and health of living resources in the estuary.

Intermediate outcomes can be expected to occur relatively early, in contrast to some end outcomes, which may take years to show up. Monitoring progress on these earlier outcomes are thus important for



managing estuary protection efforts. In fact, estuary protection activities often set in motion a series of sequential outcomes, indicating that a multiple categorization of outcomes is helpful.

Four categories of outcome indicators appear especially relevant to estuary protection activities.(1) Each is described below. The first three categories are intermediate outcomes.

- **First-Order Outcomes (Behavioral Change):** These indicators assess the extent to which desirable estuary protection actions have been adequately implemented by governments, businesses, or households.

These indicators do not provide information on whether water quality or the condition of living resources has changed, which are third- and fourth-order outcomes). The Government Action Checklist and the business, household, and boater survey procedures focus primarily on first-order outcomes. For example, the Government Action Checklist procedure (see [Section 4](#)) measures and tracks the extent to which local governments have implemented actions aimed at estuary protection. However, having implemented such actions does not tell whether there are improvements in the amount or quality of effluent, in water quality, or in the condition of living resources in the estuary. Similarly, the outcome indicators used to track protection actions taken by households and boaters (see [Section 6](#)) and by businesses (see [Section 5](#)) also represent first-order effects. These actions are important first steps but do not indicate how successful the actions were in reducing pollutants, improving water quality, or improving the condition of the estuary's living resources. Other indicators are needed to track progress on these latter elements.

Many if not all first-order outcomes will likely be closely associated with implementation actions proposed by an estuary program's long-range plan such as its CCMP. Thus, measuring these outcomes will be a major way to track progress in implementing these plans.

- **Second-Order Outcomes (Pollution Reduction):** These indicators provide information on the extent to which actions have led to reductions in pollutant discharges.

Amounts of various pollutants or other hazardous substances discharged into the water or air from various businesses are examples of this category of outcome indicator. Because considerable effort to monitor discharges is already underway across the country, this manual does not describe data collection procedures for measuring amounts of pollutant discharges. The business, household, and boater survey procedures, however, provide information on whether businesses, households, and boaters report having reduced their discharges. But these surveys are not likely to be a reliable source for learning the actual amount of such reduction.

- **Third-Order Outcomes (Water Quality):** Such indicators provide information on the extent to which water or sediment quality has changed.

These include such frequently used indicators as BOD, amounts of potentially hazardous chemicals in the water, and amounts of pathogens and fecal concentrations. This manual does not describe the detailed data collection procedures for obtaining values of each potential component of these indices. That information is highly technical, and well beyond the scope of the effort reported here.(2) However, in [Section 7](#) we discuss how technical data on water quality can be combined with indicators of fourth-order

effects to produce a comprehensive Bay Quality Index.

- **Fourth-Order Outcomes (Living Resources): Indicators of fourth-order outcomes provide information on the extent to which the health of fin fish, shellfish, other wildlife, habitat and vegetation, and the region's economy has changed.**

This category also includes indicators of the extent to which an estuary can support individual uses such as swimming and shellfishing.

In Exhibit 2.1 (not available on the electronic version) we summarize these four categories of outcomes in a chain-of-events diagram. In Exhibit 2.2 (not available on the electronic version) we illustrate this progression of outcomes for a specific estuary protection activity: an effort to encourage industrial firms to reduce the amount of hazardous waste generated. Getting firms to seek training and technical assistance in hazardous waste reduction is a first positive step and is shown as outcome indicator #1 in Exhibit 2.2 (Note that measurements such as the number of events held by the estuary program are not outcomes but rather measure the amount of program *work activity*.) It is even more useful to measure the number of businesses that made constructive changes in their use and handling of hazardous material(not available on the electronic version)s/waste (outcome indicator #2). Both of these indicators measure first-order outcomes. Reductions in the amount of hazardous waste generated and amount of individual pollutants discharged by these businesses (outcome indicator #3) are second-order outcomes. Even better outcomes are improvements in the quality of receiving waters (outcome indicator #4), a third-order outcome. Ultimately, the results desired are improvements in the condition of the estuary's fish, other wildlife, vegetation, and in the ability of citizens and businesses to use the estuary's waters (outcome indicator #5), which are fourth-order outcomes.

In Exhibit 2.3 we present another example of this outcome progression using local ordinances as a starting point. *Categorizing outcome indicators is important in providing a clear perspective to officials and the public on the ultimate importance of individual indicators.* It should also enable users of the outcome information to keep in perspective which results are relevant to the ends ultimately sought by estuary protection activities.

Note that although these four orders form a cause-effect chain, estuary actions do not necessarily have to start at the beginning of the chain. For example, some water clean-up activities (e.g., of PCBs) might not affect first- or second-order indicators but would directly impact water quality and subsequently the health of living resources, which are third- and fourth-order impacts.

Monitoring outcome indicators that measure first- and second-order outcomes has the advantage of enabling users to track estuary protection progress in a more timely fashion. First- and second-order outcomes generally occur relatively soon after program activities, while third- and fourth-order outcomes often occur later. Fourth-order outcomes changes to living resources sometimes may not occur until many years after corrective actions have been taken. The purpose of outcome monitoring information is to provide timely information that public and private officials can use to help them make program decisions. Decisions often cannot wait; officials need information to help them make decisions even if

the information available is far from ideal and represents only intermediate outcomes. Thus, first- and second-order outcomes provide early indications and can be considered proxy indicators of end outcomes.

# Implementing an Outcome Monitoring system

Below are recommendations for estuary programs to consider in implementing their own outcome monitoring systems.

*Derive the outcome indicators from mission statements after considering the perspectives of the various customer groups.* Use such sources as:

- Legislation;
- A strategic plan such as a CCMP if it already exists;
- Interviews with federal, state, and local government officials, key area businesses, local environmental protection organizations, boating groups, and households (this approach was heavily used for the outcome indicators presented in this manual);
- Focus groups with representatives from the above groups;
- Data elements already available in the community; and
- Work done in other estuary programs (including the indicators illustrated throughout this manual).

*Seek information on multiple outcome indicators of estuary protection performance.* Estuary protection involves multiple aspects. For example, estuary programs are likely to want to track progress in encouraging local governments, businesses, and citizens to implement problem-reduction activities, as well as to track the end outcomes such as improvements in the health of living estuary resources. Each of these requires separate outcome indicators. In [Section 3](#) we present an illustrative set of outcome indicators.

*Break out selected outcome indicators by key characteristics that are expected to be of importance to program officials and managers.* This will make the outcome information much more useful to program officials. Desirable breakouts are likely to include geographical characteristics (such as breakouts of the Bay Quality Indices by political boundaries or segments of the estuary waters); type of industry (such as breakouts of the extent to which businesses in particular industries have improved their hazardous material handling); source of impairment; type of recreational activity; and type of household (such as indicators of household estuary protection behavior by size of household, income, and whether the homes are owner-occupied or rentals).

*Provide outcome information to officials on a regularly scheduled and timely basis.* Outcome reports should be provided at least quarterly to reflect seasonal considerations. However, data on some outcome indicators will need to be collected more frequently, while it will not be feasible to obtain data on other indicators as often. For some indicators, annual data collection or less frequent collection will be

appropriate. However, the reports should include all outcome measurements, noting that some have not been remeasured during the previous quarter.

*Compose outcome reports that are understandable and useful to nontechnical audiences such as policy officials and the public.* The outcome reports described in this volume are not intended as technical reports for the scientific community. These outcome reports should be clear, concise, and readable by a nonscientific, nontechnical audience. This does not mean that the indicators should not be technically sound, but they should be presented in a way comprehensible to most readers. Outcome reports should show relevant comparisons by presenting data from previous reports and showing progress against outcome indicator targets established for the period. Though data for many of the outcome indicators may only be roughly right, that is, not precise in a technical sense, such information should be much more useful to officials who need to make program and policy choices than no outcome information at all.

*Avoid frequent changes to the outcome indicators.* The set of indicators should be reasonably stable over time so that progress and trends can be identified. A relatively fixed set of outcome indicators should be used. Of course, improvements in measurement will occur, and the appearance of new estuary problems or the emergence of improved measurement techniques may require revisions to the set of indicators. When modifications are made to existing indicators, provide estimates of the effects.

*Limit the number of performance indicators to avoid overwhelming users, but have back-up detail available.* Some outcome indicators will need to be composite measures, that is, indicators representing aggregations of two or more component indicators. For example, the Government Action Checklist procedure (see [Section 4](#)) involves identifying the progress made by each local government in implementing individual estuary protection actions. Outcome reports for public officials should contain summary indicators, with the information on each specific action available as back-up information when needed. Similarly, the Bay Quality Index (see [Section 7](#)) is a composite of a number of individual measurements. Information on each component indicator should be readily available to those who want more detail.

*Provide relevant explanatory information in each outcome report along with the outcome data.* Many external and internal factors can affect outcomes. Such information should be included, particularly when the outcome values deviate substantially from expected values. For example, natural elements such as major rainfalls or hurricanes can have major effects on some outcome values. If these events affect the outcome data significantly, their occurrence should be flagged in the outcome reports. Explanatory information might include quantitative data such as major population changes, amount of precipitation, and temperature data or qualitative information such as reports on the number of major businesses that entered or left the area, or that a fish disease not believed to have been caused by human activity appeared. Explanatory information should, when possible, indicate the likely effects on the outcome indicators and identify when any planned corrective actions are likely to show up in the outcome indicator values. Explanatory information provides program managers with the opportunity to give their views publicly on why progress was not as great as expected and to identify planned actions to correct

observed problems, thereby reducing the likelihood that elected officials and media will unfairly place blame on program officials for not achieving desired results.

*Consider setting annual and long-range targets for the values for each outcome indicator.* The program can subsequently track progress relative to the targets. Such targets should be set only after considering the resources (dollars and personnel) that the estuary program expects to be available and any external factors likely to aid or hinder progress. This target setting probably should be part of the development of the estuary program's annual action plan and CCMP or other goal-setting mechanism.

## Cost and Effort Required for Outcome Monitoring

What will these procedures cost? The outcome monitoring process should, of course, be one that the estuary can feasibly implement with as low a cost in dollars and staff time as possible. Environmental monitoring data will be the basis for most third- and fourth-order performance indicators (such as for the Bay Quality Indices described in [Section 7](#)). Data collection for environmental monitoring will usually be the most expensive data to obtain. Estuary programs need to make tough decisions about which items to measure, how frequently to measure them, how large a sample to use, and which geographical segments of the estuary to cover. Estuary programs already make similar choices as they collect environmental monitoring data for scientific purposes. For outcome monitoring systems, which involve frequent (quarterly) reporting, estuary programs need to give consideration to:

- Frequency of environmental data collection;
- Timing of collection;
- Which geographical segments need separate measurements; and
- How much data precision is needed.

Each of these factors has substantial influence on data costs.

Estimates of approximate cost and personnel time needed for the other data collection procedures are discussed in the relevant sections of this manual. Each procedure requires time, effort, and some added dollar costs for personnel time, mailings, and so on. The added dollar costs of each of these procedures appear likely to be small, but finding staff time for administration will be an added burden, especially for already busy program staff. To the extent that volunteers can be used to help with these activities, both dollar costs and staff burden can be reduced. In many cases, the monitoring data may already be available from other sources at little or no cost.<sup>(3)</sup> The start-up effort required to develop the procedures and to pilot them will be the most burdensome problem. However, once the procedures have been established, data collection in subsequent years should be considerably less burdensome.

## Final Comments on Overall Procedures

Each estuary program will need outcome indicators that measure progress in addressing the particular environmental problems and priorities of that estuary. Each locality will need to choose data collection procedures based on local needs and available measurement resources. The basic principle is to use measurement and reporting procedures that provide reasonably valid and useful information for assessing estuary protection outcomes. The estuary program should regularly report on each indicator until the indicator becomes obsolete or until it clearly is no longer worth collecting and reporting.

Perfect measurement is not possible. Many measurement problems exist and will continue to exist. The measurement procedures should be the best ones currently available to the program within its resources. The procedures should make as much use as possible of the latest scientific and technical knowledge and should be sufficiently precise to help program officials make decisions that help them improve estuary protection. Standardized data collection protocols should be used throughout the estuary to the extent feasible. However, a desire for perfection and scientific precision should not deter the use of outcome indicators and data collection procedures that do not meet rigorous standards. *It is better to be roughly right than to have no information at all.*

## Notes, Section 2

1. In effect, this is a four-level version of the six-level categorization currently being used by the Chesapeake Bay Program and EPA's Office of Water. Their levels 1 and 2 ( Actions by EPA/State Regulatory Agencies and Response of the Regulated Communities ) are both included as first-order effects. Level 3 corresponds with our second-order effects. Levels 4 and 5 ( Changes in Ambient Conditions and Changes in Uptake and/or Assimilation correspond with our third-order effects. Level 6 corresponds with our fourth-order effects.

2. See, for example, American Society for Testing and Materials, 1993, Compilation of Scopes of ASTM Standards Relating to Environmental Monitoring. Philadelphia, Pa. 3. An excellent discussion of volunteer monitoring relating to environmental condition indicators is contained in: *Volunteer Estuary Monitoring: A Methods Manual*, EPA 842-8-93-004, December 1993; and *Volunteer Water Monitoring: A Guide for State Managers*, EPA 440/4-90-010, August 1990; both from U.S. Environmental Protection Agency Office of Water, Washington, D.C.

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# Measuring Progress of Estuary Programs

## Illustrative Outcome Indicators

[Selecting Outcome Indicators](#)

[Examples of Outcome Indicators](#)

[Reporting Outcome Indicator Values](#)

In this section we present an illustrative set of outcome indicators that estuary protection programs can use as a starting point for their selection of outcome indicators. We also briefly address the process of indicator selection and the characteristics that individual and sets of indicators should have.

## Selecting Outcome Indicators

Outcome indicators are the backbone of any outcome monitoring process. The values that are regularly obtained for each indicator provide the basis on which estuary program officials determine progress in bay protection. These values also help officials allocate scarce resources based on where outcomes seem to be achieving desired results and where they are not.

It is vital that outcome indicators be selected to:

- Cover the major measurable outcomes for the estuary;
- Represent a reasonable consensus among key estuary program officials;
- Provide reasonably valid data that can be obtained for each indicator; and
- Supply data that can be obtained within available budget and personnel resources (including voluntary assistance).

We suggest the following basic steps for selecting outcome indicators:

1. The estuary program leadership forms a special working group to draft the set of indicators. For estuary programs with formal policy, management, technical, and/or citizen committees, representatives from each of these should be represented in the working group.

2. The working group examines available mission statements and identifies currently available data related to outcomes, identifying what is being collected, when, how often, and by whom.
3. Working group members meet individually with representatives from interest groups, including environmental groups, industry, citizen groups, local and state governmental officials and staff, boaters, commercial fishermen, the scientific community, and so on. These representatives are asked what outcomes they believe to be important and what results they would like from estuary protection activities.
4. The working group synthesizes the many outcome indicators identified from the previous steps, examines them for overlap and relevance, and combines the remaining candidate outcome indicators into a central list. The list may still be too large for practical coverage. The working group members should discuss the individual candidate outcome indicators, rate each on criteria such as those shown in Exhibit 3.1 (not available electronically), and rate importance of each indicator. For example, to reduce the list to a more manageable size, each working group member might give each indicator a low, medium, or high importance rating. This procedure was used effectively in both the Buzzards Bay Project and the Tampa Bay NEP.
5. The working group prepares the specifications for each selected outcome indicator including its rationale, data source, and limitations. Exhibit 3.2 (not available electronically) is a sample outcome indicator specifications sheet that might be used for this purpose.

## Examples of Outcome Indicators

[Exhibit 3.3](#) presents an illustrative set of outcome indicators that might result from a process such as that described above. This set is based on indicators prepared by the Buzzards Bay Project office. Both the Buzzards Bay Project and the Tampa Bay NEP believe that the indicators should be grouped by subject. The Buzzards Bay Project grouped its indicators into the following categories, based on those it had used in its completed CCMP:

- Reducing toxic pollution,
- Preventing and managing oil spills,
- Managing sewage and septage,
- Managing storm water and agricultural run-off,
- Protecting wetland and coastal habitat,
- Managing boat-related waste,
- Managing nitrogen,
- Managing on-site septic systems,
- Managing shellfish/finfish resources.

The Tampa Bay NEP sorted its indicators into the following categories:



- Septic systems,
- Municipal waste,
- Hazardous waste and materials,
- Storm water,
- Dredge and fill,
- Oil pollution and emergency response,
- Boat use and boater discharges,
- Agriculture and industry,
- Shellfish closures,
- Land use,
- Public information and technical assistance,
- Miscellaneous.

The estuary program's outcome monitoring working group should select categories that best represent the long-term concerns of its particular estuary program.

To these categories, we have added the category Overall Summary Outcome Indicators, shown on [Exhibit 3.3](#). This group of indicators is intended to contain a small number of indicators that provide a more comprehensive picture of overall bay quality and of the outcomes of the major activities undertaken by the local estuary program. The summary indicators in Exhibit 3.3 include an overall Bay Quality Index (see [Section 7](#)) and indicators that summarize the outcomes of activities aimed at affecting environmental protection behavior by local governments, households, boaters, and businesses. Estuary program officials should select those summary indicators that they believe can best provide a comprehensive picture of overall estuary protection progress.

Once the outcome indicators have been chosen by estuary program officials, estuary program staff can prepare a specification sheet on each individual outcome indicator, such as that shown in Exhibit 3.2. These specifications identify the rationale for the indicator, the data collection procedure or source, frequency of collections and reporting, and who (what organization) is responsible for data collection and data quality. As discussed in [Section 2](#), the specifications also should identify what, if any, breakouts should be made of the indicator data, such as geographical breakouts for bay quality indicators, or breakouts showing environmental behavior of particular types of households.

## Reporting Outcome Indicator Values

The set of outcome indicators forms the basis for an estuary program's regular outcome monitoring efforts. An estuary program should obtain and report data on a regular (e.g., annual) basis for each indicator. Some examples of report formats are presented in Sections [6](#), [7](#), and [8](#) of this manual.

The estuary program should also examine the data on each outcome indicator, including subsets of data, in order to help estuary program officials determine where progress is occurring, where it is not, and

where additional effort and resources are likely to be needed. For example, data on the indicator Governments That Have Met at Least 75 Percent of the Items on the Government Action Checklist (see [Exhibit 3.3.](#)) should be examined to identify which checklist items and which governments have not yet achieved the targeted results. This information will indicate where estuary program personnel might provide technical assistance.

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Note: This information is provided for reference purposes only. Although the information provided here was accurate and current when first created, it is now outdated.

# Measuring Progress of Estuary Programs

## Tracking the Progress of Local Government Estuary Protection Efforts: The Government Action List

[Purpose of the Government Action Checklist](#)

[Major Characteristics of the GAC Approach](#)

[The Process for Developing a GAC](#)

[Formulating a GAC Process](#)

[Analyzing and Reporting Government Action Checklist Information](#)

[Effort and Cost](#)

## Purpose of the Government Action Checklist

At all levels of government federal, state, and local regulatory actions, resource allocation such as for public health agents to monitor shellfish bed openings and closures, and other activities such as technical assistance or public information campaigns have major implications for estuary protection. We suggest identifying major activities of relevant governments that have ramifications for the estuarine environment and placing them on a Government Action Checklist (GAC). Each year, the extent of achievement of the items on the checklist can then be assessed to track progress. In this section we present a framework for tracking the progress of estuary protection activities undertaken by local governments in the estuary area. In the future, it is likely to be useful for estuaries to develop parallel GACs that relate to state and federal activities.

The GAC procedure provides a vehicle for annually monitoring the overall progress that local governments are making in their efforts to protect an estuary. The assessments of progress made by each government in implementing bay protection activities should also provide each area government with a scorecard for its own actions, as well as permitting each local entity to compare its progress to that being made by other governments in the area. The GAC assessments also will enable private organizations and the public to keep track of this progress.

The Tampa Bay NEP, in its pre-CCMP period, is using the GAC process as a step in developing an action schedule for its CCMP. The Buzzards Bay Project, having completed its CCMP, which provided a major portion of its checklist items, is using the GAC process to help it measure progress in meeting the goals of the CCMP.

In general, the GAC procedure should increase awareness of the relationship between governmental activities and environmental consequences. This should encourage environmental planning by each community and focus attention on issues that the community needs to address. *The procedures described here do not attempt to assess the effectiveness of these government actions, only to document that the actions have taken place.* Other outcome monitoring and evaluation procedures are needed to assess the effects of these actions.

The material in this chapter is based largely on the efforts of the Buzzards Bay Project and the Tampa Bay NEP. In the Buzzards Bay Project, a citizens' group called The Coalition for the Buzzards Bay Project had already been using an Environmental Report Card for a few years to assess the efforts of 12 watershed communities surrounding the bay in protecting groundwater and coastal water. Their approach served as a catalyst for developing the GAC model presented here.

Below we describe the major characteristics of the GAC approach, the process for developing a GAC, the steps in formulating a checklist, analysis and reporting of GAC information, and the effort and costs involved.

## Major Characteristics of the GAC Approach

1. A checklist should cover key government activities affecting the estuarine environment, including:
  - Ordinances,
  - Planning activities and documents (e.g., soil conservation plans),
  - Compliance and enforcement activities,
  - Best Management Practices (BMPs) programs promulgated in specific areas of concern or for selected audiences (e.g., sectors of agriculture or industry),
  - Public information and technical assistance efforts.
2. The GAC should be administered on a regular schedule, probably annually, to permit estuary managers, local governments, and the public to monitor progress on a relatively frequent and timely basis.
3. The GAC process should cover all government entities that have a significant role in protecting the estuary. The checklist items used in this manual are limited to local governments. It also is desirable to monitor items that relate to state (or even federal) government activities, although separate checklists are needed for such purposes.

4. The number of items in the checklist should be limited to between 50 and 75 items. The focus of the GAC should cover primary issues and actions identified by the CCMP, if a CCMP has been prepared.
5. Individual checklist items should apply to most, if not all, of the governments included in the monitoring activity. If an item does not apply to a specific community, this should be clearly delineated (e.g., items that apply to septic systems might be designated inapplicable for a town that does not have such systems).
6. The checklist coverage should be determined with the participation of the local governments. The involved governments, as well as other interested organizations, should be given ample opportunity to express their views on which items should be included in the GAC.
7. The items on the GAC should be carefully defined and specified so that those undertaking the status assessments in future years will be able to reliably determine whether or not the government has fully undertaken the actions specified by the items. Prepare a rating scale for each item on the GAC to enable those conducting the assessments each year to make reliable, useful ratings.
8. An objective, respected organization should implement the annual GAC assessments.
9. A summary assessment of each government's progress should be prepared and disseminated to estuary protection organizations and the public. Although an overall grade could be assigned to each government based on the ratings (as is currently being done in the Buzzards Bay Project by the Coalition), there are less controversial ways to summarize the findings for each government and for the area as a whole.
10. The method for reporting the information should be carefully considered and structured so that it is as helpful and constructive as possible. Governments should be given the opportunity to review the ratings and provide explanatory information prior to any public dissemination of the findings.

## **The Process for Developing a GAC**

The estuary program should establish a GAC working group comprising representatives of each of the estuary program's primary committees (e.g., technical advisory committee, citizens' advisory committee, policy committee, management committee), local scientific experts, representatives of each local government likely to be assessed using the GAC process, and pragmatists with a sense of what is needed by management, policy-making officials, and the public. Including a broad segment of the community will both improve the quality of the procedure and help gain support for subsequent effective implementation.

The group should expect to complete its work within 12 months, during which time members will shape the GAC process, select the checklist items, oversee the conduct of the pilot test, and formulate reporting

requirements and formats. Although the development process could be speeded up, it is not advisable to do so because a shorter timetable decreases the likelihood of obtaining the input desired from many groups in the affected area. The working group should:

- Identify users for the information that the process is intended to generate, define the desired system characteristics and the advantages and disadvantages of such outcome assessments, and discuss the steps needed to obtain baywide support for the checklist process;
- Identify and discuss the desired performance characteristics to be tracked, including how the items would be assessed;
- Determine data collection procedures, including identification of organizations or groups that are candidates to undertake the annual data collection;
- Determine how the information will be scored and presented to the local government and the public.

The working group will need to spend several months examining the relevance, likely validity, and usefulness of individual indicators, and revising the checklist and procedures accordingly. Once the group has achieved consensus that the GAC is nearing completion, it should solicit input from a wider range of local government representatives.

One way to accomplish this is by having working group members circulate the draft to members of the affected agencies in their respective governments. These other agencies can be asked to make additions, recommend items that should be deleted, and prioritize those items that should be considered for inclusion (in the event that the listing needs to be streamlined). Reviewers should be provided with criteria they can use in making their recommendations. For example:

- Does the item describe an action/activity that is of significant importance to bay protection?
- Is the wording of the item specific and accurate?
- Does the item cover an important activity not otherwise captured?

After the review cycle has been completed and a reasonably complete version of the GAC generated, the working group should define the selected items, finalize an appropriate rating scheme, and conduct pilot testing of the draft instrument. Once the pilot test has been completed, the working group should reconvene to:

- Review the pilot test results,
- Consider difficulties that arose and identify what steps need to be taken to eliminate such problems in the future,

- Use the pilot test results to test the utility of the planned reporting formats,
- Estimate the costs of the ongoing process, and
- Formulate recommendations on the future implementation of the GAC.

## Formulating a GAC Process

The basic steps in formulating a GAC process are listed in Exhibit 4.1(Not available electronically). Each of these steps is discussed in the following sections.

### Step 1: Select the Items to Be Included in the Checklist

The first step is to identify the relevant activities that governments should undertake to protect the estuarine environment. This entails identifying a comprehensive list of potential items, then reviewing the list to ensure that key issues have been adequately covered and that redundant items and those of marginal importance have been removed. The group formulating the checklist and other reviewers of draft GAC materials should seek to limit the length to a reasonable number of high-priority items, probably 75 or less.

Several sources can yield possible items. These include:

- Local government staffs and other experts,
- CCMPs or other official estuary goal/action statements,
- Local ordinances that detail actions that governments have taken,
- Model ordinances that identify future activities that might be desirable to undertake,
- State comprehensive plans,
- Regional policy plans,
- City and county comprehensive plans,
- Land development regulations (LDRs), and
- Emergency response plans such as those pertaining to oil spills.

The set of potential items should be grouped into categories that highlight key topic areas of concern to estuary managers. [Exhibit 4.2](#) presents the categories used in developing the GACs for the Buzzard Bay Project and the Tampa Bay NEP. Since the Buzzards Bay Project had completed its CCMP development process, it drew heavily from the CCMP in deriving both the categorization scheme and the selection of specific items. The Tampa Bay NEP, on the other hand, had not yet completed its CCMP. Therefore, in formulating its GAC structure, the Tampa Bay NEP chose topics that were central issues guiding its CCMP development process, including only those items on which there was a clear sense of agreement among participants.

Several criteria should be considered in evaluating candidate indicators, as well as during the final selection of checklist items:

- *Their usefulness in encouraging government action.* Items should be useful for local government planning purposes.
- *The extent to which there is evidence that the item is important to estuary protection.* Some items may be controversial or the jury may still be out on them from a technical perspective. Such items probably should be excluded from the GAC.
- *The extent to which the indicators can be affected by local government.* For example, activities and actions regulated by state or federal governments, over which local governments have little authority, should generally be excluded. However, where actions are covered by federal or state laws, GAC items can be included, if expressed in terms of whether the local government is in compliance with the existing federal or state law. Actions beyond the statutory authority of the area governments should not be retained in the final GAC. (Note: Some governments may not be responsible for some items in the checklist. For example, counties, as opposed to towns or cities, may be responsible for some items. If so, the items would be rated for counties, but not for cities or towns.)
- *Overlap with other items.* Items that overlap in a substantial way with other items should be revised or deleted.
- *Measurability.* For some items under consideration, it could be quite difficult to make a reasonably reliable assessment of progress by jurisdictions. If ability to make a reliable assessment is questionable, the item probably should not be included in the checklist.

After the initial draft list has been prepared, the GAC working group and the local government experts in each area should review the GAC section by section to determine which items should be retained and what additional items should be considered for inclusion. This may involve several review cycles to achieve consensus on the set of final checklist items. In the Buzzards Bay Project and the Tampa Bay NEP, four cycles were needed to finalize the indicators. Both estuary programs had the working group members rate each candidate item as to its importance, e.g., high, medium, or low, to help determine the final set. Exhibit 4.3 presents the instructions provided to individuals who served as reviewers for the Tampa Bay GAC.

Once a final set of items has been determined, these should be sequenced within categories for substantive clarity and temporal and logical consistency.

## **Step 2: Determine Which Governments Will Be Included**



The GAC working group needs to consider whether the GAC monitoring should apply to all communities that feed into the watershed, only the local governments participating in the estuary program, only the larger entities such as cities and counties but not the smaller municipalities, or some other configuration. For example: The Tampa Bay NEP decided to start with three major counties and three large cities. Some counties included as many as 22 municipalities a number thought to be unwieldy for individual assessment in the GAC process. Moreover, many of the municipalities were thought to have small impacts on bay quality. A number of the items on the Tampa Bay GAC refer to county-level activities that are not applicable to the towns.

In contrast, the Buzzards Bay Project has targeted GAC monitoring for each of the communities that were signatories to the CCMP. The procedure currently covers 12 local governments. The Buzzards Bay Project developed three versions of the GAC: one for coastal towns, one for inland towns, and a separate checklist for New Bedford the only large city in the local area and the area's industrial manufacturing hub. In estuaries with local government units numbering in the hundreds, the working group will likely want to focus on governments believed to have the greatest influence on bay quality or, alternatively, to rotate the GAC coverage, monitoring the smaller, less influential communities, say, every three years.

## **Step 2: Operationally Define Each GAC Item for Assessment Purposes and Develop a Rating System**

This step raises two primary measurement issues:

- How to locate the source of the information for each item and how the information is to be collected, and
- How to rate achievement of each item. The measurement scheme should define items as clearly and specifically as possible so that they can be objectively rated. The more specific the item wording, the easier it will be to obtain relevant information and conduct the rating. The item definitions should enable those doing the assessments to reliably determine whether or not the government has fully undertaken the action intended by the item. Thus, an early effort should be to ask the local experts to be as precise as possible in defining each item on the checklist.

For example: In the Tampa Bay NEP, the item, The local government promotes the use of innovative and alternative wastewater systems (such as batch treatment processes) at appropriate commercial, industrial, and large residential land use sites was operationally defined as:

- Identifies appropriate potential users and disseminates information to them,
- Provides incentives for use,
- Mandates the use of innovative and alternative wastewater systems by appropriate users. Similarly, in

the Buzzards Bay Project, the item, Has the town developed . . . embayment or harbor management . . . for their entire coastline to guide the use and protection of sensitive areas? was defined as:

- Conducts townwide assessment of coastal natural resources (i.e., eelgrass beds, shellfish beds, fringing marshes, and so on),
- Designates dock- and mooring-free zones based on sensitive natural resources,
- Establishes boat exclusion zones and boat speed limits to minimize adverse effects on natural resources,
- Defines where dredging is permitted and where it is not,
- Specifies times of the year when construction or dredging are permitted in order to minimize ecosystem impacts. In defining each item, rely on user-friendly terminology. The phrase home septic system, for example, is more easily understood by both potential government respondents and GAC raters than on-site disposal system.

A rating scale needs to be prepared for each item on the checklist to enable those doing the assessments each year to make reliable, useful ratings. If the rating scale gets too long or involved, those doing the ratings may be unable to make such fine distinctions, and the process may become excessively complicated and time-consuming.

A two-level scale ( yes or no, has or has not been achieved) is probably too simplistic for most items. A three-level scale such as fully accomplished, partially accomplished, or not accomplished at all will probably be adequate for most items. If an item does not apply to a specific jurisdiction, it should be marked not applicable. For example, using the Tampa Bay NEP wastewater item referenced above, a local government would receive a rating of:

- Fully accomplished if it has identified appropriate potential users and disseminated information about innovative and alternative wastewater systems to them; provided incentives for use; and mandated the use of innovative and alternative wastewater systems by appropriate users. (Note that this particular item does not cover having an active monitoring and enforcement program relating to the mandate. The checklist also should contain such an item.)
- Partially accomplished if it has implemented some, but not all, of the three identified sub-issues.
- Not accomplished if none of the sub-issues had been achieved. The quality and effectiveness of the government's activity is not relevant in this process and should not be considered when making ratings. The rating is based on whether the activity/action identified in the wording of the checklist item has been undertaken. Therefore, the rating should focus on actions governments have already taken, not on those intended in the future. For example, the existence of a plan to carry out some action should not be viewed

as the equivalent of having accomplished the action. However, as noted in the Tampa Bay NEP, some plans (e.g., city and county comprehensive plans) implicitly carry a binding obligation to act, and therefore estuary managers may decide that local governments should be given credit for partial accomplishment if they have a specific schedule for carrying out a recommended action.

The rating categories and their definitions should be detailed in an annotated version of the GAC. Appendix 1 presents sample checklists developed by the Buzzards Bay Project; Appendix 2 contains the Tampa Bay NEP checklist.

## **Step 4: Select the Organizations that Will Administer the Rating Process for Subsequent Implementation of the GAC**

The organization that ultimately conducts the assessment should be one that is perceived as being reasonably objective by the governments being rated and by the public. It is probably preferable to accomplish this by relying on a regional organization such as a Council of Governments, a regional planning association, or a university.

Selecting another organization to administer the ratings has an additional benefit to the estuary program. The program is thereby removed from having to judge organizations with which it must retain an ongoing working relationship. The program is thus better able to support those organizations as they address any deficiencies noted by the rating entity. Training sessions should be held for those persons who will do the ratings and should be held each time the assessments are made. This is important to facilitate inter-rater reliability and consistency across raters within the same timeframe or from one year to the next.

The organizations should preferably have:

- In-house staff expertise on pertinent environmental issues and local government procedures,
- On-line capacity to access relevant data, and
- A reputation for credibility and objectivity. Another option is to use a citizens' group such as a bay watch group or the League of Women Voters. If it becomes necessary to use citizen volunteers to conduct GAC assessments, estuary managers should exercise considerable care in their selection and training. These efforts may have to be supplemented by local experts on GAC items that require some technical knowledge. When this is the case, it may be advisable to split the instrument into sections and have the more technical items handled by individuals with expertise on those items. If volunteers are used, it is particularly important to provide substantive rater training sessions to ensure the quality of the work.

The Tampa Bay NEP has contracted with its the Tampa Bay NEP Regional Planning Council to

undertake the first GAC effort. The Buzzards Bay Project has chosen to contract with a local citizens' group the Coalition for the Buzzards Bay Project. The Coalition uses some paid staff and some volunteers.

## **Step 5: Pilot Test the Assessment Procedures**

Once the working group has settled on a final draft version of the checklist and has completed definitional guidelines for the ratings, the GAC should be field-tested to identify difficulties with the items, their wording, or the assessment procedures. The location selected for the pilot test should resemble the local government areas that will receive the final version of the GAC in order to be a fair test of potential usefulness. Rarely will the first version of the GAC survive unmodified as it undergoes a pilot test among selected local communities.

For example: For the pilot test of the Buzzards Bay Checklist, one town (Fairhaven, Mass.) was selected for a trial run of in-person interviews with agency personnel. Coalition staff arranged meetings in Fairhaven with appropriate town officials to complete the checklist. Several improvements were suggested, and the checklist is undergoing appropriate revision.

The distribution of any materials being circulated externally should be handled carefully and with sufficient information to allay participants' concerns. Even though representatives of local government agencies will have been involved in developing the checklist, some individuals who receive the materials during the pilot test (or during subsequent administrations of the annual GAC) may not have first hand familiarity with the GAC or with their agency's prior participation. Unless adequate information is expressly communicated to them at the time they receive the checklist, such persons may be hostile or suspicious and may not cooperate with the information-gathering effort needed to make the ratings.

To facilitate each local government's understanding of the GAC and encourage it to cooperate, representatives from relevant local agencies should be briefed prior to distribution of the checklist. Such briefings should include in-person meetings as well as clearly written instructions. Discussions between estuary staff and local agency personnel should minimally cover the following points:

- Background concerning the Government Action Checklist and its role in estuary management, with appropriate reference to the CCMP or other goals/objectives adopted for the estuary;
- How the checklist was generated, including explanations of why items have been grouped or categorized as shown in the draft version of the checklist;
- Acknowledgment of all local participants in the GAC development process;
- Timetables for the pilot test and the sequence of events and anticipated timing for reporting results, including announcement of any decisions made concerning frequency of the exercise;

- Schedule and method for revising the GAC based on pilot test results, and local agency participation in this process if desired;
- Illustrations of sample reporting formats;
- Steps to alleviate local agency fears of unfair ratings, including giving agencies the opportunity to provide explanations for their actions or failure to act, as well as permitting agency review of ratings prior to dissemination of GAC findings.

Limitations of the checklist or the ratings procedures also should be identified and discussed. These include items such as:

- Reminders that the quality of the activities is not measured by the GAC process;
- Recognition of the difficulties inherent in dealing with an unweighted set of checklist items, that is, the fact that various actions are unequal in terms of their contribution to estuarine protection. For example, a local law requiring owners to clean up animal wastes, while desirable, is not likely to have the same potential effects as implementing advanced water treatment.
- Acknowledgment of the fact that lag times, cause-and-effect linkages, and externalities prevent generalized assumptions about the relationship between checklist items and bay quality.

The discussion also should focus on the specific activities that must be undertaken to ensure satisfactory and timely completion of the GAC assessments. These include considerations such as:

- How the rating process will be implemented, including who will compile the information used to make the rating, what local government agencies should be involved in providing relevant information to the raters, what information they will need, suggested sources of relevant information, and the appropriate level of detail required.
- How the ratings will be reported and how local government personnel can indicate the context or reasons for failure to achieve the highest GAC ratings. The GAC working group should be particularly sensitive to local governments' concerns about ratings that could lead to public criticism of their performance. For example: The Coalition for the Buzzards Bay Project for several years used a report card format with grades (A through F) assigned to town performance. Because local governments were graded so specifically, they developed a higher level of anxiety than would have arisen had they been simply rated as falling along the continuum from full to non-accomplishment of selected items. The comparisons, however, had the benefit of creating competition among the towns and generating interest by the press that translated into citizen interest.
- Even where report card-type grading is not part of the assessment process, comparisons will be made of government performance across locales and over time within each local area. Therefore, GAC

procedures should allow for governments to provide explanatory narratives addressing special circumstances or conditions that might have mitigated against accomplishment of specific GAC goals.

- *The need to designate a single individual to represent each participating government.* The raters will need to obtain information from many agencies in a government in order to complete the ratings.

For both the pilot test and subsequent use of the GAC, it is important to identify how to collect the information needed for the ratings. Several options exist. One possibility is to mail the checklist to local governments, asking them to indicate by mail what they have done with respect to each item on the GAC. Another option is to mail the checklist to each local government in advance, then hold in-person discussions between the raters and designated local government representatives to document current status. A third option is for the raters to track the information themselves with a minimum of input from the government staff. This last method is a good option if the raters are technical experts who are familiar with each government's status on the subject matter.

In the Buzzards Bay Project, for example, a Coalition staff member distributes the GAC to a single point of contact in each local government. The latter individual is then responsible for distributing the GAC to the appropriate local boards for completion. The evaluator then follows-up in a face-to-face format with representatives of the boards to clarify and expand the information needed to make a rating.

The Tampa Bay NEP, on the other hand, is mailing out the checklist to designated government representatives after an initial kick-off meeting that addresses procedural and information requirements. Local government representatives will mail their responses, together with supporting documentation, to the Regional Planning Council responsible for completing the ratings.

Regardless of which approach is used, the GAC project staff should designate a GAC contact to respond to local government questions or concerns about GAC items or procedures.

For the pilot test and subsequent ratings, schedule about a four-week period for the rates to obtain the information needed for their ratings, including distribution and return of completed checklists from the local governments. Remind local governments of the due dates midway through the scheduled period, by phone or mail. Avoid allocating too little time for completion (resulting in respondent frustration and inability to complete the task within the desired time) or too much time (causing respondents to view the exercise as low priority, since there is no immediate need to respond).

## **Step 6: Determine the Analysis Process and Reporting Formats**

Analyzing and reporting the findings is a critical step in the process. Central to the design of reporting formats is that the data be meaningfully aggregated, clear and accessible to a range of users, and of practical use for estuary management purposes.

# Analyzing and Reporting Government Action Checklist Information

The following are likely to be the key analytic and reporting elements for tracking government agency estuary protection progress:

1. Calculate and report for each category of government action (such as toxins reduction, storm water and agricultural runoff management) the number and percentage of GAC items that all communities together have achieved. Also calculate these figures for each community. This will provide information on which categories of environmental protection appear to be doing well and which are not so that encouragement and technical assistance can be provided to those communities needing assistance.
2. Calculate and report the number and percentage of assessed *communities that showed improvement* on one or more checklist items from the previous assessment. Some estuary protection programs may want to use a more stringent criterion such as the number and percentage of communities that improved on, say, three or more of the checklist items. This information indicates where progress has been made. Together the outcome information here and in #1 identify the latest level of achievement and progress made over the past year giving a more complete and fairer picture of each community's estuary protection status.
3. Calculate and report the number and percentage of *checklist items that each community, or the estuary program itself, had previously identified as priority* and for which the assessment showed an improved level of achievement since the previous checklist assessment. This type of reporting is probably attractive to local governments. Local governments would be asked, during each GAC reporting cycle, to specify their own priorities for the coming year.

For example: The Buzzards Bay Project local government representatives requested the opportunity to identify at the beginning of each year those checklist items that were of priority for their towns. Each town would subsequently be assessed on achievement of its priority items. The government representatives felt that these steps would be useful for their own planning effort. This procedure complemented, rather than replaced, an analysis of all checklist items.

Special attention could be paid to reporting the extent to which each government had achieved its stated objectives. This information should be particularly useful to individual communities on the progress that each had hoped to make, providing a comparison of actual versus targeted achievement.

Similarly, estuary programs may elect to set targets or prioritize GAC items into high, medium, and low objectives. The Tampa Bay NEP, for example, is considering setting targets two years in advance so that local governments would know what short-term standards of accountability they will be measured against. Once targets are set, the number and percentage of local governments that have achieved stated priorities can be reported.

4. Calculate and report the number and percentage of *all checklist items that each assessed community has achieved*. (This is the grand total of #1 for each community, across all categories of government action.) This information provides a summary indicator of accomplishment for each community. Estuary program officials may choose to use such a report to compare achievement among its communities (as has been done in the Buzzards Bay Project). This is a useful strategy if done constructively and can provide encouragement to move forward on estuary protection. However, if, because of adverse media or inter-community relations, an antagonistic atmosphere exists, the comparative checklist information may aggravate those problems. In such cases, estuary program officials may want to play down the report card aspects of the presentation.

5. Tabulate and report (but probably to a more limited audience) the *number and percentage of communities that have achieved each item on the checklist*. This information is more detailed than will be wanted by most outside organizations and the public. However, such tabulations permit estuary program officials to focus on specific protection activities that warrant special attention, helping identify needed encouragement and technical assistance efforts.

A *Summary of Survey Findings*, as illustrated farther below in [Exhibit 6.6](#) (on the findings of household surveys), should be prepared. The analysts should identify selected key findings from the latest survey findings. Significant progress made over previous checklist assessments should be highlighted progress made both by individual communities and by the estuary program as a whole.

In addition to these analyses, outcome information should be accompanied by selective explanatory information. This information should focus on checklist items that the assessments indicate have significant problems or have been significantly improved. The personnel in each local government responsible for the items should be encouraged to provide explanatory information on significant findings, and should be given the opportunity to do so before the report is disseminated externally. This will allow government personnel to present their reasons and identify any actions they are taking to correct problems or, if they choose, to dispute the assessments. The opportunity to provide explanatory information is needed for the sake of fairness, to help interpret major findings, and to make the outcome monitoring process less threatening since the public and officials know they will have the opportunity to provide their side of the story.

Clarity of format is of special importance. The art of presenting complex data is often overlooked by agency personnel. Estuary program staff should carefully consider design alternatives before finalizing their reporting format. Draft reporting formats should be examined not only by estuary management staff, but also by local government representatives to ascertain that the data are meaningfully displayed. Information sorted by unclear or inaccurate headings may cast doubt on the validity of the data and the process.

Technical jargon and extensive use of acronyms should be avoided. Formats should be designed so that past measurements (from previous years) appear alongside current data for ease in identifying progress.



Trends are often very useful, sometimes even more useful than current measurements. The use of grading systems is effective for many purposes and acceptable in many locales, but normally detracts from the main purpose of performance measurement to provide managers with indications of where modifications might improve outcomes.

The GAC should be useful for local government planning purposes and for estuary management. For this reason, we recommend:

- Highlighting in each community's report progress on the items that the community had identified as priorities for the past year;
- Giving assessed governments the opportunity to provide explanatory information on their ratings. These explanations should be included in the annual monitoring report prior to its official release. Inclusion of this feature will reduce the threatening aspects of the GAC and provide users with relevant supplementary information.
- Asking the administering organization to estimate whether the cost of meeting each shortfall is negligible, small, or high (e.g., requires construction).

The purpose of these added steps is to assist individual communities in better planning and to provide information that enables the communities, together with regional organizations, to undertake joint planning.

Each estuary program needs to ensure constancy over time once it establishes a format for its GAC. Revisions to the format in the early years should be avoided if possible, since one purpose of the GAC is to identify both positive and negative changes over time. Although there has to be some flexibility to modify items so that the GAC continues to be relevant in future periods, it is important to design a stable core set of checklist items that will permit assessment of trends.

Finally, schedule a public event to announce the annual GAC results. For example, the Tampa Bay NEP plans to design an event during which results of the pilot can be disclosed and discussed.

Feedback from this meeting will provide information about changes needed or important additions. Such a meeting can bring together representatives of several local governments, thereby enhancing communication, networking, and technology transfer within and across various agencies and areas.

## **Effort and Cost**

The GAC working group members require roughly 12 months to develop and pilot test the process. Once the process has been developed, the ratings constitute the major ongoing activity. For example, the Buzzards Bay Project estimates that the annual rating process takes approximately three calendar months.

The time and cost required to do the ratings will depend on the number of items in the checklist, their complexity, and the number of local governments covered. The Buzzards Bay Project and the Tampa Bay NEP each allocated approximately \$13,000 for the process to be conducted by an outside organization. Each process involved less than 15 local governments.

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Note: This information is provided for reference purposes only. Although the information provided here was accurate and current when first created, it is now outdated.

# Measuring Progress of Estuary Programs

## Tracking the Outcomes of Business-Related Estuary Protection Activities

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Businesses and industries, including agriculture, are often major contributors of pollutants to an estuary. Thus, they provide major opportunities for pollutant reduction. Progress in encouraging business and industry to adjust their operations in order to produce less hazardous polluting materials should be tracked, as should the actual magnitude of pollutants emitted. Obtaining such information can be used to identify where estuary protection activity is needed and the extent to which past activity has been successful.

National Pollution Discharge Elimination System (NPDES) permits can be examined for direct dischargers, and the permitting and monitoring programs accompanying these permits can provide significant information. However, the accumulation of discharges from the hundreds of businesses and industries around an estuary into a publicly owned water treatment system is often an even greater problem. By-products of businesses ranging from small paint and body shops to mortuaries and electroplating industries often discharge hazardous wastes, many of which are difficult to eliminate by standard public treatment systems before discharge into the estuary or stream. The public treatment system itself is occasionally, and sometimes chronically, hampered or damaged by these discharges.

Public and private agencies can have a variety of waste reduction and pollution elimination programs for businesses and industries. Educational and technical assistance programs can be provided to businesses and industries to disseminate or attract attention to best management practices for specific sectors of commercial operations. Regular inspections can be conducted to develop information as part of the

permitting program.

# Procedures for Tracking Outcomes

Three primary data collection procedures are discussed here for tracking the outcomes of business-related estuary protection activities:

1. The primary way to track progress in reducing hazardous waste is to monitor the data on pollutant loadings, such as the data obtained from the tests required by permitted businesses from tests performed by the Publicly Owned Treatment Works (POTW, which also operate under an NPDES permit). These data include discharges to the air as well as to the water. Thus, indicators of loadings should normally be included as part of an outcome monitoring system and measure second-order effects. Some effluent data are collected at the end of pipes that accumulate pollutants from many sources. Such data provide an aggregate outcome indicator, but do not necessarily show the outcomes for efforts directed at specific businesses or industries, especially the many small businesses that can discharge pollutants. The next procedure can help here.
2. The second procedure involves tracking the extent of actions taken by businesses to reduce their hazardous waste. The primary method for doing this is to administer periodic (annual) surveys of businesses to ask them about their activities relating to hazardous waste reduction. This is an excellent way to track the effects of training and technical assistance efforts provided to businesses, and is the central subject of the remaining parts of this section.
3. Finally, as the list of outcome indicators presented in Section 3 ([Exhibit 3.3](#)) suggests, progress by individual local governments can be tracked by looking at the extent to which they, for instance, urge use of alternatives to hazardous materials used by businesses, sponsor industrial pre-treatment programs, and implement agriculture pesticide/fertilizer best management practice programs. Progress by local governments can be measured using the Government Action Checklist procedure described in [Section 4](#). For example, the Buzzards Bay Project focused on reduction of toxic materials discharged by local businesses in the New Bedford, Massachusetts area.(1) New Bedford is the largest city adjacent to the estuary and historically has been a center for the manufacture of textiles, advanced electronics, seafood, jewelry, and other products whose manufacture produces high volumes of hazardous or toxic materials. The Acushnet River, forming a spine of industrial development and draining into the estuary through the central city, has been contaminated with PCBs to the degree that the river has been designated as one of the nation's two underwater Superfund sites. The Buzzards Bay Comprehensive Conservation and Management Plan included a pollution prevention program for toxic waste generators as one of its eleven action plans.([Section 6](#) provides further suggestions.
9. *Should only assisted businesses be surveyed or all potentially polluting businesses?* All businesses or at least representative samples of all businesses should be surveyed. This provides a much more complete picture of what is happening in an area and also provides a comparison group of non-assisted businesses

(so that actions of assisted businesses can be compared to those of non-assisted businesses). For initial surveys conducted before an assistance program begins, the estuary program will need to survey all businesses (or a sample thereof) in order to obtain baseline information from which changes can be measured. If the estuary program chooses to survey only assisted businesses, it should do so before assistance is given and every one or two years thereafter. Higher response rates can be expected from businesses that have been assisted. The number of assisted businesses is likely to be small enough to undertake a 100 percent sample without being overly costly.

## The Questionnaire

A sample questionnaire is presented in [Exhibit 5.1](#). A different questionnaire would need to be developed for some types of businesses such as agriculture. The questionnaire in the exhibit is adapted from one prepared by the Buzzards Bay Project/Urban Institute team after extensive field interviews with EPA national staff, reviews of EPA documents, and interviews with town and environmental officials and with selected representatives of larger industries. The questionnaire probably should cover such topics as:

- (a) Particular hazardous waste-reduction activities that a potential polluting business has underway such as a waste reduction plan and reduction targets, training sessions, and in-plant waste reduction assessments;
- (b) The extent of use by the business of local hazardous waste-reduction training and technical assistance programs;
- (c) Evaluations by respondents of any assistance received;
- (d) Whether the business has modified any of its materials or processes to reduce hazardous wastes (but these surveys are not likely to be an appropriate source for data on the actual magnitude of effluent volume changes);
- (e) Whether the magnitude or type of hazardous waste has actually been reduced; and
- (f) Information or technical assistance the business believes it needs and would like to have.

The questions for potential polluters were prepared based on discussions with or materials provided by the U.S. EPA Pretreatment and Multi-Media Branch and the Massachusetts Executive Office of Environmental Affairs' Office of Technical Assistance (based on the latter's prior work with the electroplating, metal working, and auto body shop industries). In Buzzards Bay, the Project staff developed a list of 125 firms in New Bedford to be surveyed. A questionnaire and cover letter were developed, and the first mailing was sent in July 1993. The completed questionnaire was intended to provide baseline data for toxic reduction activity as well as data on what assistance the businesses would like.

The questionnaire should be short, preferably no more than two sides of one sheet of paper. A short letter introducing the purpose of the survey should be included. An illustrative cover letter is shown in Exhibit 5.2 (not available electronically). Naturally, each estuary protection program will need to tailor the cover letter to its own circumstances.

Questions such as those in [Exhibit 5.1](#) should not be unduly complex or intrusive. The low response rates that initially occurred in Buzzards Bay indicate the need for the survey to be preceded by a substantial educational effort. As noted earlier, this might include having industry representatives assist in preparing the questions, having local business associations cosponsor the survey, holding workshops, attracting media attention, and having businesses determine who from the companies would be responsible for completing the questionnaire. It would be appropriate to provide a hotline telephone number to assist in clarifying questions.

The information obtained from the survey can be used to judge progress in future years when the survey is repeated. In the short term it can be used to help structure technical assistance.

## Analyzing and Reporting the Survey Results

Below we suggest how to report the results of business surveys in ways that will be most useful to estuary program officials.

1. Tabulate and report for each question the percentage of respondents that provided a response. Then calculate and report the number and percentage for each category of business. Businesses might be categorized by such characteristics as size (perhaps using two to five size categories), type of business (farms, food service, small paint and body shops, mortuaries, electroplating industries, or groupings of businesses), and location (city, county, or town). These data (along with other information such as estimates of the amounts of hazardous or toxic wastes disposed of by various categories of businesses) will provide information to estuary program officials to help determine where future estuary protection efforts should be targeted. The format used in [Exhibit 6.5](#) for household surveys can also be used for tabulating data on the questions included in the survey of businesses.

2. After repeat surveys have been conducted, identify time trends and where improvements have occurred. This information will be particularly useful for identifying the results of estuary program efforts to encourage or assist certain categories of businesses. It will provide estuary program officials with evidence on whether their efforts have led to desired outcomes. The evidence will be stronger if changes in outcomes for assisted businesses are compared to those of unassisted businesses.

3. Provide explanatory information along with numerical data where relevant. For example, if business activity had significantly increased or decreased during the year, or if the estuary protection program had assisted a particular industry (perhaps in a specific section of the estuary) to improve handling of toxic or hazardous materials and waste, this might explain findings of such improvement. Such information will provide estuary program officials with a better perspective on why the outcomes occurred.

4. Prepare a Summary of Survey Findings like that shown in [Exhibit 6.6](#). This information will help public and private officials understand the major findings from each business survey without having to wade through extensive tables.

# Effort and Cost

Because data on actual effluent pollutant levels presumably will be obtained from already existing sources, the cost of collecting them is likely to be negligible for the estuary protection program.

The survey of businesses, however, will require extra effort and a small amount of cost, especially the first time the survey is done. Initial development of the process to be used for obtaining feedback from businesses, including development of the questionnaire, will likely require considerable time on the part of estuary program staff and business representatives. However, once the process has been developed and tested, regular surveys of samples of businesses are likely to be inexpensive. Administration would normally be by mail, with perhaps two mailings and a reminder card. Some telephone follow up and interviews will likely be needed to encourage non-respondents to complete the questionnaire. Drawing the sample of businesses, preparing addresses, doing the mailing, and keeping track of returns all require clerical time. Entering the data and getting tabulations will also require clerical and a small amount of analysts' time.

## Notes, Section 5

1 Toxic wastes are normally those wastes that are found to contain high concentrations of heavy metals or specific pesticides. *Hazardous wastes* include toxins but are more broadly defined to include any wastes that could cause injury, death, or may damage or pollute natural resources. Many hazardous wastes are listed in the RCRA regulations. Other hazardous wastes are identified by characteristics such as ignitability (solvents), corrosiveness (acid), or reactivity (bleach). In 1986, the Massachusetts Department of Environmental Management estimated that 194,163 tons of hazardous and toxic wastes were generated and handled in that state.

2 See *A Toxic Waste Source Reduction Program for Buzzards Bay*, prepared by the Buzzards Bay Project, June 1992.

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# Measuring Progress of Estuary Programs

## Measuring Outcomes of Household and Boater Estuary Protection Activities

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[Questionnaire Design](#)

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Households and boaters play major roles in estuary protection. Their actions can hurt or help the estuary's condition. Households affect estuary quality by their use of fertilizers and pesticides, disposal of contaminants (such as paint and cleaning materials), and upkeep of private septic systems. Boaters affect estuary quality by dumping waste, mishandling fuel, and damaging submerged aquatic vegetation with their propellers. Most if not all estuary programs provide information and assistance to households and boaters aimed at encouraging them to act in ways beneficial to estuary protection. A key issue is the extent to which the behavior of households and boaters is changing as a result of protection programs designed especially for them. Tracking such outcomes is likely to be an important element of an estuary program's outcome monitoring effort.

An estuary program may also want to assess periodically the outcomes of *specific* outreach activities. Information on current behaviors provides estuary officials with needs assessment information to help them allocate their limited resources. For example, surveys can measure the extent to which estuary publications have reached targeted groups and whether the public is familiar with estuary protection resources available in the local area.

The major way to assess the status of, and changes in, household and boater estuary protection behavior is to survey them periodically about their environmental protection-related activities. Theoretically, another option is to observe this behavior. However, observation procedures would likely require an expensive, labor intensive effort and are unlikely to reveal a complete picture of a household's or boater's behavior.



Estuary programs have the option of tracking the extent of illegal boater behavior by examining the number of boater violations reported. This measurement source, however, has severe drawbacks. Unreported violations will probably be much larger than the number of reported incidents, and many adverse behaviors are not illegal. Therefore, boater surveys would likely be needed to provide more complete information.

The outcomes obtained through such surveys of household and boater behavior are first-order outcomes. Improvements in behavior can be expected to lead to reduced amounts of contaminants discharged into the waters of the estuary, and subsequently to improved water quality and life conditions for animals and vegetation. Below we discuss: questionnaire design, how the questionnaire should be administered, how to select the survey sample, and how to report the findings. Exhibit 6.1 (not available electronically) summarizes the major steps needed to undertake household surveys.

This material draws heavily from the experiences of the Tampa Bay NEP in its survey of households across the Tampa Bay area and its specialized survey of households located in Tampa Bay's Florida Neighborhood Program. It also draws on the Buzzards Bay experience with its boaters' survey.

When examining changes in household and boater behavior from year to year, small observed differences are not likely to be as important as large differences to estuary program officials. This means that large household and boater samples yielding a high degree of precision are not likely to be needed.

# Questionnaire Design

## Issues to Be Covered by the Questionnaire

The topics chosen for the questionnaire and the specific wording of individual questions have a major effect on the survey's ultimate usefulness.

The first step is to identify potential problem areas relating to household estuary protection behavior. These problem areas can become the subjects for the individual questions. [Exhibit 6.2](#) is an illustrative list of potential household behavior areas likely to be of concern to estuary programs. An estuary program can start with this list as a way to begin its own identification of which potential problem areas are important to include in its own household and boater questionnaires.

The selection of the questions to be covered by the questionnaire can be made through a process involving a working group of both technical personnel familiar with potentially dangerous household and boater activities and household and boater representatives. Recruiting household representatives should not be a problem because at least some of the technical representatives are also likely to be residents of the estuary region, thus acting as both technical and household representatives. The working group should identify potential problems relating to the estuary's quality (such as those listed in [Exhibit 6.2](#))

and break them into specific behavioral issues, about which specific questions should be framed for the questionnaire.

In Tampa Bay, the team developing the household questionnaire had the advantage of a recently prepared publication that identified the types of actions that households could take to help improve the quality of the bay (*Tampa Bay Repair Kit: RX for a Healthy Bay*, Tampa Bay NEP, St. Petersburg, Fla., 1993.) The team preparing the questionnaire used problem areas identified in the pamphlet. It also used the household actions suggested in the pamphlet for selecting some of the response categories for questions included in the survey. Other estuary programs can draw from this and similar types of publications in developing their own questionnaires.

The working group should identify both problem areas and household characteristics that are likely to affect or be related to household and boater behavior. This background information should be collected from each responding household. When cross-tabulated to household (or boater) behavior findings, such information enables the estuary program to relate the findings on behavior to household characteristics. For example, in its household questionnaire Tampa Bay sought descriptive information such as:

- Household composition (size and presence of children);
- Whether respondents owned or rented their homes;
- County of residence (the Tampa Bay Estuary affects three major counties; the questionnaire asked for county of residence as a way to identify whether the programs appear to be more effective in some counties than others and which ones might need more intense assistance);
- Whether the respondent lived in an apartment, condominium, or mobile home as distinct from a house (in order to exclude that group for questions relating to methods of lawn fertilization, pesticides, materials used for walk areas, and so on).

Obtaining such information enables estuary program officials to break out the outcome program indicator values for each category. This will help identify whether a problem primarily occurs with households of one particular type or in one particular county. Estuary program officials can subsequently direct resources to those particular households.

## Question Wording

A major step in developing the questionnaire is to develop the specific wording of each question, including the appropriate response categories for each question. For an environmental protection survey, this task requires special attention.

The specific wording and order of the questions should be prepared with extensive input from people knowledgeable in questionnaire design. Assistance can be obtained from local universities. It is easy to frame questions in a biased manner that does not appear biased to persons inexperienced in questionnaire design. The wording, of course, has to be put into terms that will be readily understood by respondents. This is particularly so if the questionnaire is to be administered by mail, where the respondent has little

or no opportunity to clarify the meaning of a word or phrase. For example, in Tampa Bay, a question originally contained the word xeriscape. This was changed to drought tolerant plants to be clearer to respondents. In fact, even the phrase drought tolerant plants may not be sufficiently clear and should be simplified further, perhaps to something like plants that need little, if any, water.

Response categories should cover all possible responses and be worded in specific terms so that desirable environmental protection responses can be distinguished from those that are undesirable. For example, some types of mulch may be undesirable. For the questionnaire findings to be useful, the estuary program will want to obtain tabulations of the number and percentage of households that report positive as distinct from negative activities. The information can then be used to help the estuary program direct its attention to those areas where there appears to be a significant amount of negative environmental behavior. The estuary program can plan or expand activities aimed at assisting households to improve those estuary protection behaviors.

The working group should carefully review the initial versions of the questionnaire, even if prepared with the assistance of a survey expert, to assure that the questions and their wording capture the information wanted.

The questionnaire should then be pre-tested. That is, it should be tried on a small number of households or boaters representing a cross-section of households to whom the questionnaire will be administered. A pre-test does not mean merely giving the questionnaire to respondents to see if they answer all the questions. It also means that pre-test respondents should be asked whether they had any problems in understanding questions. On question wording that the working group itself found to be problematic, respondents should be asked to give their understanding of what those words or terms meant to them. Based on the findings from the initial pre-test, the questionnaire should be revised. If the problems are substantial and require significant questionnaire modifications, the questionnaire should be again pre-tested.

To our knowledge, there is no scientific way to determine how many persons should be included in a pre-test. The estuary program should probably include about a dozen households in its pre-test. If these households have problems with the questionnaire, the working group should add additional households to the pre-test until it feels confident the questionnaire is reasonable.

Because of the likely variety of households in any estuary, the questionnaire will need to include some skip patterns so that households with certain characteristics skip over some questions. For example, households that live in apartments should not be asked questions about lawn fertilizers because they are unlikely to be sufficiently informed about the maintenance of grass areas outside their apartment units. Similarly, boaters without marine sanitation devices do not need to be asked about their use of pump-out facilities.

Appendix 3 (not available electronically) presents a modified version of the household questionnaire used by the Tampa Bay NEP. Some of its questions are unique to that region of the country and will not

likely be applicable to other estuaries. Appendix 4 (not available electronically) presents a modified version of the boaters' questionnaire used by the Buzzards Bay Project, which focused on waste disposition given the local area's recent enactment of a No Discharge Zone. In contrast, a boaters' survey for the Tampa Bay NEP would likely reflect that area's concern for protection of seagrass.

Finally, in areas with significant numbers of non-English-speaking residents, the estuary program may need to provide different language versions of the questionnaire.

## Mode of Administration

The survey questionnaire can be administered to households and boaters by mail, by phone, in person at their home or dock, or by a combination of the above.

*Mailing the questionnaire* is likely to be the most feasible method for most estuary programs. It is usually the least expensive approach. Its major drawback is that unless the process is handled properly, response rates may be so low that the results will not have sufficient validity and credibility.

Administration by *telephone* is the survey technique most favored by survey organizations. However, it is a more labor-intensive effort since it requires time to train interviewers, locate and reach potential respondents, and complete and document the interview. Completion rates, however, are likely to be substantially higher than for mail surveys if the phone interviewers repeatedly call back numbers until contacting the respondent.

*In-person household interviews* are not likely to be feasible for most estuary programs given the considerable amount of interviewer time required for travel to respondents' homes. These days, interviewers are also reluctant to go into certain areas of their communities, particularly in the evenings when people are most often available for interviews.

Some exceptions exist. For example, Tampa Bay's Florida Neighborhood Program had personnel that provided direct assistance and information about environmental protection to a small number of households within pre-selected neighborhood areas. In such situations, program staff are in a position to deliver the questionnaires to homes and then return to pick them up or to offer to complete an interview at the person's home or elsewhere in the neighborhood. This procedure should be able to produce a high completion rate at very low cost, but adds extra work for program personnel.

One option for administering boaters' surveys is to access a sample of boaters at their docks when they return from trips. This approach is likely to become feasible if the estuary program can assign volunteers or staff to primary docking locations around the estuary at various times of the day, days of the week, and seasons. In Buzzards Bay, the boating season lasts from April until mid-September.

The most satisfactory approach for estuaries is likely to be a combination of mail and telephone

administration in order to bring the response rate up to reasonable levels at a reasonable cost. We suggest that estuary programs seek a 50 percent rate of return, excluding questionnaires that were returned because the family had moved or otherwise were ineligible for the survey. The estuary program will need to undertake a second and perhaps third mailing to non-respondents to increase the response rate. After the second mailing the program should follow up non-respondents by phone to remind them to complete and return the questionnaire, or if preferred, to complete the interview by phone.

The first mailing should request the completion and return of the questionnaire by approximately the third week after the date the questionnaire is mailed. An example of a mail questionnaire cover letter is shown in Exhibit 6.3 (not available electronically). In addition to the information shown here, the cover letter should also indicate that the information provided will be confidential and it should identify who can be contacted for more information on the survey. The second mailing, with a new updated cover letter and another copy of the questionnaire, should be sent shortly after the first is due. This requires the survey team to identify households that have already returned the questionnaire. The second mailing should give a new date for returning the questionnaire, about two weeks after the follow up is mailed.

Usually it will be desirable to code each questionnaire to identify which households have returned the questionnaires and which have not. It is quite appropriate to guarantee in the cover letter that the responses will be confidential and that only aggregate data will be reported. However, it is not necessary to guarantee complete anonymity, at least not from the program personnel administering the survey.

The cover letter can give households the option of contacting the survey team to be interviewed by telephone rather than completing the questionnaire in writing. This option is not likely to be used by many households, but some might have literacy problems, feel uncomfortable with a written questionnaire, or otherwise feel more comfortable talking to someone at the survey office.

## **Improving Response Rates**

Exhibit 6.4 (not available electronically) presents suggestions to increase the likelihood that households will complete and return mail questionnaires.

The questionnaire and the cover letter should indicate the date by which the questionnaire should be returned. Judgments differ on how much time should be allowed. Allowing a period of about two to three weeks from the date that the questionnaire is expected to be mailed is probably appropriate. The due date should not be so far out in the future that people will put it off and lose the questionnaire. On the other hand, the time allotted should be long enough to allow for mail delivery and for respondent's possible absence or other commitments.

For boater surveys, endorsement and even cosponsorship of the survey by local boater associations would likely be very helpful. In such cases, it is preferable that the cover letter be signed by the association president as well as an estuary protection program official, to encourage boaters to respond to the survey.

# Selecting the Households and Boaters to be Surveyed

The survey team will need to determine the listing of households and boaters to be used to draw the sample, the sample size, and the procedure used to select the sample from the list.

## Sample Source

If the survey is by telephone, the survey team could draw from recent telephone directories to obtain its sample, assuming that the number of households without telephones and with unlisted numbers is not expected to be large enough to significantly affect the findings. A more sophisticated approach that takes care of the unlisted phone problem is to use random digit dialing, a procedure that should probably be used with the help of an expert in random digit dialing (again, contact a local university). An easier option is to draw a sample from the phone directory and then increase each drawn phone number by one. This makes the telephone numbers random and will, thus, cover listed as well as unlisted numbers.

If the questionnaire is to be administered by *mail*, addresses can be obtained from telephone directories. But in addition to the problems mentioned above, telephone directories used for mailing purposes do not provide ZIP codes. Therefore, someone will probably need to identify the ZIP codes for each address. Telephone directories are usually reasonably up-to-date (persons who have resided in the community for less than a year probably should not be surveyed).

However, use of phone directories can present problems if the directory boundaries do not match those of the target area for the estuary. The Tampa Bay NEP survey initially used the telephone directories for each of three counties. This procedure yielded problems because a number of households were found to reside in communities outside the survey region to be surveyed (phones listed as being in one town were sometimes found later to be located in another, out-of-the-area location).

The Tampa Bay NEP found a more efficient device the use of reverse directories, directories arranged by street address that provided addresses, zip codes, and in most cases phone numbers (that can be used for telephone reminders or phone interviews). These directories, prepared by business firms, may also contain additional useful information such as apartment numbers. (If the estuary program wants to exclude households that are in apartments, the reverse directory will enable this to be readily done.) Unfortunately, reverse directories are usually prepared only for high-population areas. Reverse directories can be used for both mail and telephone surveys.

In some small communities it might be feasible to use real estate rolls, utility billing addresses, or other government lists. In doing so, the survey team needs to carefully determine whether some types of households they want to include have been excluded, or that some they would like to exclude are included. For example, real estate rolls would exclude renters. Utility bills would include some renters

including apartment dwellers.

No list is likely to be perfect. But as long as the survey team uses comparable lists each time it conducts the survey and is able to obtain reasonable response rates, comparisons across time should be reasonably valid.

For boater surveys not administered at the dock, the survey team might use available listings of registered boaters or of local boating clubs. This would not cover visiting boaters, but their behavior is less likely to be influenced by estuary protection activities. However, questionnaire administration at the dock can cover visitors if they are felt to be a major offender group and if the estuary program believes it can take actions that would have a tangible effect on visiting boaters' behavior.

## **Sample Size**

For surveys where the total target population is small (under 500), the questionnaire can normally be administered to 100 percent of households. Tampa Bay's Florida Neighborhood Program administered questionnaires covering all of the few hundred households included in the program.

For area-wide household surveys such as the Tampa Bay household survey, administering questionnaires to all households clearly is infeasible. Even the larger estuary programs are unlikely to be able to survey more than 1,000 households. Smaller estuary programs should be able to handle mail surveys of about 300 to 500 households without much trouble. Note that statistically it is better to get a higher completion rate from a smaller sample than a much lower response rate from a larger number of households.

For example, it is usually much better to receive 100 completed questionnaires from 150 households (a 67 percent response rate) than to receive 1,000 completed questionnaires from 150,000 households (a 10 percent response rate). The 10 percent response rate raises a significant possibility of non-response bias (i.e., that non-respondents differ from respondents in significant ways in their responses).

A complicating factor is that the estuary program is likely to want information on various sub-groups of the full sample. This increases the sample size needed. For example, if an estuary program wants to obtain reasonably statistically valid information for each of three counties, it is likely to want to seek a sample return of at least 300 questionnaires about 100 from each county. If it expects a 50 percent response rate, a mailing of 600 will be needed.

When compiling addresses (or telephone numbers if the survey is by phone) for the sample, the survey team also needs to consider the number of households on the list that are likely to be ineligible for the survey. Some households may be found to have moved or to live outside of the eligible area. For example, if about 20 percent of households in the listing are expected to be ineligible, the number of households that should be drawn initially assuming a 50 percent response rate is sought is 375 if the number of completed questionnaires sought is 150, 750 if 300 completions are sought, and 1,250 if 500 completions are sought.

# Sample Drawing Method

After determining the size of the sample and the sources from which it will be drawn, the next step is to draw the sample from the list. The survey team needs to estimate the total number of households in the list from which the sample is to be drawn. That number should be divided by the sample size to give the approximate sampling interval. For example, if the listing contains 100,000 households (a community of between 250,000 and 300,000 population) and the survey team wants a sample of 750, the team needs to choose one out of every 133 listings. Such a selection can be done in a number of ways. One relatively simple procedure is to randomly select a starting point in the directory and then choose every 133rd listing.

Counting the number of listings in each directory and selecting every 133rd listing need not be done exactly, but should be roughly right. The principle here is to draw the sample in a way that reduces potential biases. The persons drawing the sample should look out for listings that are not relevant or not eligible to be sent a questionnaire such as a business or government office or, if the survey is not intended to include them, households living in apartments, trailers, and condominiums. If the questionnaire is not intended to target certain groups of households such as renters, the questionnaire itself should include a question to screen out renters.

# Analyzing and Reporting the Survey Results

Typically, agencies put too little time into considering how the information should be reported. Below we discuss both the analysis of findings and their presentation.

## Analyzing the Information

When questionnaires are returned, each should be reviewed to ensure that the responses given are clear and fit into the appropriate response categories. This is particularly important in mail surveys because respondents sometimes make errors such as missing skip patterns. For example, in Tampa Bay respondents living in an apartment, mobile home, or condominium were instructed to skip over questions about maintenance of lawns and septic systems. On occasion, some respondents provided responses to questions they were asked to skip. The questionnaire editor should correct those entries by marking and tabulating those answers as non-applicables.

If a respondent provides an ambiguous response by, say, putting a check mark half-way between response categories, the editor will have to treat the responses as if the respondent had not answered them. However, if these questions are felt to be of major importance to the study, the survey team might go back by phone to that respondent to clarify the responses. But this is seldom likely to be needed or appropriate.



The numerical tabulations should be done by computer. Many software packages are available that permit the ready entry and tabulation of questionnaire data. Standard software programs such as SPSS and SAS do have such tabulation capability, but their use requires individuals knowledgeable of the software.

Though we do not recommend it, if necessary the tabulation work can be done by hand using a spreadsheet approach by listing each respondent in a row and using each column to enter the responses to a different question. Manual tabulations are feasible if the number of households in the sample is relatively small, say up to about 300, and if the survey team does not need to make many cross-tabulations.

Manual tabulations can readily provide one or two sets of cross-tabulations such as findings broken down by county or by whether respondents own or rent their homes. Different spreadsheet pages would be used for each category. The findings can then be tabulated for each page and totaled. If, however, the survey team wants to tabulate a number of such cross-tabulations, the manual work quickly becomes difficult to handle and is subject to substantial potential tabulation errors.

## Presenting the Findings

Findings should generally be presented in at least two different types of formats. The first format presents the *numerical results*. These can be presented in tables and charts by reporting the percentage of respondents that gave each response for each question, perhaps entered on a copy of the questionnaire. Another way to present numerical results is by providing tables for each question (see [Exhibit 6.5](#) for example). Note that the principal numbers used in the presentation are percentages the percentage of the total sample that responded in each way to each question. The number of households that responded to the question is also included to give users a perspective on sample size. The format shown in [Exhibit 6.5](#) also allows users to see readily whether substantial differences in responses occurred for different categories of households.

The data should be analyzed for each environmental problem behavior. These data should also be examined to determine whether specific categories of households (e.g., those living in particular jurisdictions, those with a certain household composition, or renters or owners) presented problems. For example, the hypothetical data shown in [Exhibit 6.5](#) indicate that proper disposal of oil, paint, and other chemicals is particularly a problem in County C and with renters, a large proportion of whom dispose of these items into sewer or storm drains.

Estuary programs are also likely to find it useful to calculate an overall outcome indicator such as the percentage of households with one or more environmental problems. This overall outcome indicator should also be broken out by household category.

When tracked over time, these measures provide an overall snapshot of progress in improving household environmental protection behavior. They indicate the extent to which efforts to provide information to

households can help improve bay quality. For example, if a large percentage of households or only certain categories of households report problem behavior, estuary program officials may want to allocate significant resources to targeting those types of households with education or technical assistance.

The summary report should also provide users with a brief description of key features of the survey: whether it was administered by mail, phone, or a combination of the two, the response rates obtained, and the dates when the survey was conducted. This information enables readers to be better able to interpret the precision and timing of the survey.

Findings should also be summarized in a short, clear narrative form that highlights the findings. This Summary of Survey Findings should identify major problems needing attention. After the survey has been undertaken more than once, the summary should identify where significant improvements or backsliding have occurred relative to previous survey findings.

[Exhibit 6.6](#) presents an excerpt from a summary of the Tampa Bay 1993 household survey. Because this was the first time the survey was conducted, the findings do not present information on time trends. The Tampa Bay survey findings indicate how survey information might be used by estuary protection programs. For example, a substantial percentage of households (25 percent) that disposed of oil, paint, or chemicals in the past 12 months reported that they had disposed of them into their sewers or outside storm drains. This indicates a problem that the environmental protection program should address in its future activities.

Such information is the major purpose of household and boater surveys. It is used to identify whether past activities have had targeted outcomes and to help identify future actions that should be taken to improve household and boater estuary protection activities.

## Limitations of Household and Boater Surveys

The information collected in these surveys should be considered roughly right. Because of major resource limitations that most estuary programs will have in undertaking such surveys, a great deal of precision is unlikely to be feasible. But it is not likely that questions in these surveys will need more precision than within five to seven percentage points.

In addition, the accuracy of household and boater responses will always be subject to some question. Respondents' possible reluctance to indicate negative environmental protection behaviors and their incomplete understanding of some environmental issues (such as the impact of boater discharges on estuary water) may affect the accuracy of their responses. Non-responses from some individuals in the sample also negatively affect the accuracy of the survey findings.

Finally, as noted earlier, household and boater surveys provide information only on first-order effects. Whether improvements in these behaviors will lead to major, significant changes in the water quality and

the condition of estuary living resources is subject to some uncertainty.

## Effect and Cost

The cost of estuary program activities that encourage households and boaters to improve environmental protection behavior and the cost of the household surveys that assess the outcomes of these activities are usually relatively small, at least compared to other types of activities.

Probably a major barrier to undertaking household and boater surveys is that estuary program personnel are not experts in survey work and do not have staff with sufficient time to do the work themselves. The major time and cost requirement for household and boater surveys is likely to be spent on initial development of the questionnaire. Once this has been developed, the administration of future surveys should require much less cost and time. Nevertheless, estuary protection programs should consider hiring a local survey organization to administer the questionnaire. The estuary program should still use a working group to help develop the questionnaire and to address basic issues such as which categories of households should be included and excluded. However, estuary program officials will find it less troublesome if they have an experienced survey organization to take care of the details including sampling, administering the survey, conducting the tabulations, and preparing the initial summary reports. Estuary program officials should, however, remain responsible for reviewing the survey findings and preparing their own summary of findings, perhaps with recommendations for future estuary program activities based on those findings.

If the survey is conducted by mail, it should generally cost no more than \$5.00 per completed questionnaire, once the questionnaire has been developed. If the survey is conducted by telephone (the preferred mode of most survey organizations), the estuary program will find the cost higher, perhaps \$15.00 to \$20.00 per completed interview. Thus, for 500 completed interviews, the contract cost should range from \$2,500 for mail surveys to \$10,000 for telephone surveys. Because of the numerous details and problems involved with undertaking a survey, we recommend that, if feasible, an estuary program contract out the survey.

## Summary

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Probably a major barrier to undertaking household and boater surveys is that estuary program personnel are not experts in survey work and do not have staff with sufficient time to do the work themselves. The major time and cost requirement for household and boater surveys is likely to be spent on initial development of the questionnaire. Once this has been developed, the administration of future surveys should require much less cost and time.

Nevertheless, estuary protection programs should consider hiring a local survey organization to administer the questionnaire. The estuary program should still use a working group to help develop the questionnaire and to address basic issues such as which categories of households should be included and excluded. However, estuary program officials will find it less troublesome if they have an experienced survey organization to take care of the details including sampling, administering the survey, conducting the tabulations, and preparing the initial summary reports. Estuary program officials should, however, remain responsible for reviewing the survey findings and preparing their own summary of findings, perhaps with recommendations for future estuary program activities based on those findings.

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Because of the numerous details and problems involved with undertaking a survey, we recommend that, if feasible, an estuary program contract out the survey.

## Summary

A random sample of households in the estuary protection area is the primary way to obtain periodic information on the estuary protection behavior of households. Conducting such surveys periodically enables the estuary protection program to track the extent to which activities aimed at improving estuary protection behavior are achieving desired results. The surveys also provide important needs assessment information by indicating what types of behaviors (by which categories of households) are present that seem likely to cause bay protection problems. The information obtained can then be used to help estuary program officials identify where they need to apply their future effort and resources.

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# Measuring Progress of Estuary Programs

## Obtaining Information on Bay Quality: The Bay Quality Index

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[Major Features of a BQI](#)

[Developing a BQI](#)

[Establishing a BQI](#)

[Analyzing and Reporting BQI Information](#)

[Limitations of the BQI](#)

[Outcome Monitoring Time and Costs](#)

The end result sought by estuary protection programs is an estuary The only practical way to assure that progress is being made toward this end is by defining a comprehensive set of measures, or environmental indicators, that can reveal progress over time. However, as Robertson and Davis point out:

Water quality is an abstract concept used to denote an overall evaluation of the condition or environmental health of a water body or resource.... A complete assessment would entail measurement of all the environmental properties of an area. This is obviously not possible as the number of physical, chemical, geological, and biological properties that can be measured in an area are immense. Instead, a relatively few properties that can provide general indications of environmental condition must be selected for measurement.(1)

How can outcome monitoring provide data useful to officials and the public without burdening them with an excess of esoteric information? We recommend summarizing environmental monitoring data into a Bay Quality Index (BQI).

The intent of a BQI is to provide a sound, reliable composite indicator of an estuary's overall quality and major components. The index is intended to capture the major bay quality features of the estuary in a straightforward and simple way. The index should be clear, understandable, and useful to public and private officials and to the public at large. It should permit the monitoring of trends in estuary quality

over time and help identify key aspects of bay quality that need extra attention. It should also enhance the ability of estuary protection officials to communicate needs and progress to citizens and the media.

The index should be scientifically sound, while recognizing that it is impossible to capture all relevant estuary characteristics in one index; resources for environmental monitoring are limited; and the index is not likely to be fully satisfying to the scientific community (or any segment of the community). However, the index should provide a reasonable and comprehensive picture of the status of the estuary at particular points in time. The index should use already available environmental monitoring data to the extent possible. (3)

Inevitably, the various components of the index will be collected at different times, with different frequencies, from different sample sizes, and possibly from different locations, depending on the nature of the component and the resources available for data collection. Thus, different component values will have different degrees of precision and validity.

It will sometimes be necessary to use proxies for the ideal measurements. Differences of opinion will exist among technical personnel on the accuracy and validity of various measurements. For example, one controversial area has been measurement of fecal coliform as an indicator of the extent to which pathogens are present in water. Another example is the use of Secchi Disk Depth readings rather than more accurate PAR (Photosynthetically Active Radiation) procedures; the former is less costly and can readily be collected by volunteers but is not likely to be as accurate as the latter.

As indicated earlier, this manual takes the position that it is better to be roughly right than completely ignorant. Thus, we recommend that the estuary use the best, most recently available data, even though some may be old or less than ideal. When the technical community believes that the data for a component have become obsolete or otherwise invalid, the component should be dropped from the index until new information is obtained. Some real-life examples of indices are the following:

Since 1984 the Hillsborough County Environmental Protection Commission (HCEPC) has calculated a Water Quality Index for Tampa Bay and its major sections. This index has been used as a starting point for both the Buzzards Bay Project and the Tampa Bay NEP to develop their BQIs. The Hillsborough index includes the parameters shown in [Exhibit 7.2](#).

- The Tampa Bay National Estuary Program is building on the HCEPC Water Quality Index. It is adding fourth-order indicators such as the condition of living resources and the extent to which the bay supports desired uses (the Hillsborough Index, as the HCEPC has pointed out, focuses solely on water quality parameters). The Tampa Bay NEP, as of this writing, is selecting the components for the index. It is considering inclusion of: (a) acreage of functionally healthy vegetative habitat such as seagrasses, salt marshes, and mangroves (these would be obtained from periodic assessments by the Southwest Florida Water Management District); (b) fish population data, including specified juvenile fish, recreational fish, and selected mammals (collected by the Florida Department of Environmental Protection); and (c)



measurements of impaired uses such as extent of shellfish bed closures, red tide counts, number of fish kills, and extent of blue-green algae blooms. (4) Commercial shellfishing has been closed in most of Tampa Bay for many years. This has not been a visible issue there because no commercial shellfishing industry has been present to act as an advocacy group for opening the beds.

- The Buzzards Bay Project has adapted the HCEPC index. The Buzzards Bay Project index uses five components: early summer morning dissolved oxygen concentrations (as a percentage of saturation); Secchi disk depth; chlorophyll; total organic nitrogen; and dissolved inorganic nitrogen to evaluate water quality degradation caused by nitrogen loading (coastal eutrophication). The index also will include the extent of shellfish resource closures a major issue in the Buzzards Bay estuary. The Buzzards Bay Project would also like to evaluate PCB concentrations in edible tissues of flounder and lobster as a way to evaluate Superfund Cleanup success. However, the Buzzards Bay Project does not yet have adequate resources for implementing such monitoring. Similarly, while the program would like to include an indicator of living resources such as habitat, bay officials feel that the high cost of such monitoring is prohibitive. They are considering monitoring the extent of eelgrass beds, but only every five years or so. These latter items are not included in the current version of the BQI.

Each estuary program needs to identify the components of its index that can best reflect bay quality. For example, neither the Buzzards Bay Project nor the Tampa Bay NEP has felt it necessary to include an indicator of salinity in their indices. However, an estuary program in which saltwater intrusion has become a major threat to wildlife would likely want to include a salinity measure in its index.

The above indices combine third- and fourth-order outcomes in the same index. Though this is certainly an option, we recommend that these be kept as separate indices.

A discussion of technical data collection methods for the various environmental monitoring parameters is beyond the scope of this report. Estuary programs, however, should recognize that alternative data collection methods often exist for individual parameters. Different sample collection methods can result in different findings. Estuary programs will, of course, need quality control steps, particularly when using volunteer monitoring procedures.

The federal government has been sponsoring substantial research into environmental parameters and data collection methods, with the long-range intent of obtaining some degree of standardization of procedures. (5) However, in the foreseeable future estuary programs will likely face major uncertainties and various options in determining what to collect and how.

## **STEP #2: Combining Individual Parameters into an Index**

Once an estuary program has identified the components for the index, the next problem, a difficult one, is to combine the values of the components into an overall index.

This requires two important steps. The first is to transform the values for each component each of which

is expressed in different measurement units into a common unit of measurement. That is, each value needs to be normalized. The second step is to combine those normalized values into an overall index value.

A basic procedure for transforming each parameter into a common metric is to map possible values for each parameter onto a 0 to 100 scale with 100 representing highest quality. Develop a relationship line, perhaps on a logarithmic scale, that relates the potential values for the parameter to the associated value on the 0 to 100 scale. This line, based on technical judgment, establishes the relationship among all possible component values and environmental quality. Examples of such transformation scales are shown (for chlorophyll, coliform, and light penetration) in Exhibits 7.3 (not available electronically), 7.4 (not available electronically), and [7.5\(5\)](#)

The next step is to apply weighting factors that reflect each parameter's importance as an indicator of the health of the bay. Most commonly, analysts apply weights to each parameter that add up to one. For example, the weights used in the Hillsborough County Index are shown in [Exhibit 7.2](#)

The respective weights can then be multiplied by each of the normalized values of the individual BQI components and added together to produce the latest value of the BQI.

## **STEP #3: Identify BQI Values That Represent Various Levels of Overall Quality**

Bay Quality Indices based on the above types of procedures will generate an index typically varying from 0 to 100, perhaps with 100 meaning very good and 0 being terrible.

These numbers will be very helpful in tracking the extent of progress from one year to the next. However, many users of the information will also need data that permit them to interpret which of these values are good and which are not good. Thus, an estuary will also need a procedure that translates values of the BQI (0-100) into categories such as excellent, good, fair, or poor. The estuary will need to select a range of BQI values for each such category.[\(8\)](#)

**Caution:** Traditional weighting systems such as those described in Step 2 can sometimes overstate the quality of the estuary. Certain values for some important index components may be so bad that, regardless of the readings for other components, the overall BQI *should* fall into the poor category. To counteract this, consider attaching an algorithmic procedure, that is, a rule that if the value of particular components exceeds particular distress levels, the overall BQI will fall into the poor category. The need for such a procedure becomes larger as the number of components used in the BQI increases, since the weight of any one component is likely to go down. Thus, very poor values of an important parameter may not have enough weight in the traditional weighting approach to push the index into the poor category.



## STEP #4: Select Sub-Indices

Most estuary programs will want more detail on outcomes than is yielded by an overall, estuary-wide BQI. Two major types of sub-indices should be considered:

- Sub-indices for various geographic segments of the estuary; and Sub-indices for various groups of components such as living resources, support of desired uses of the bay, and water quality.
- Such breakouts of the overall BQI provide estuary program public officials with much greater ability to identify where problems are occurring. They therefore enable officials to allocate scarce resources more efficiently. As officials track the BQI values over time, they can identify where conditions are improving or worsening. This provides a much better picture of what is happening, where it is happening, how successful programs have been, and where further activity is needed.

### Geographic Sub-Indices

Calculating and reporting the BQI for each segment of the bay is likely to be very useful to estuary program officials and the public. The Buzzards Bay Project is breaking out its BQI for each of its more than 30 major embayments. Water quality and fecal coliform measurements are being made for each embayment to help answer embayment-specific questions. However, the more areas covered by sub-indices, the more data (and sample points) are needed, thus raising the costs of data collection.

The HCEPC annually prepares maps that show Water Quality Index categories for each part of Tampa Bay. The 1991 map is shown in [Exhibit 7.6](#). HCEPC's annual reports include maps for both the latest year and the prior year (HCEPC has been calculating its index since 1985). The Tampa Bay NEP plans to calculate its BQI for approximately seven major sections of the bay.

### Type of Component

Some estuary protection programs will find it useful to have sub-indices based on particular categories of components such as the condition of living resources, the extent of support for desired uses, and water quality. A sub-index could be prepared for each category. The Buzzards Bay Project, for example, is currently calculating data on water quality separately from its supporting-uses category, with the latter based on shellfishing closures.

## Establishing a BQI

Most estuary programs are likely to find it useful to establish a working group to develop the BQI. This could be a subcommittee of an existing technical committee. This subcommittee, however, should also include substantial representation from management and policy personnel, because the BQI is not intended as a scientific tool but as a management and policymaking tool. It also should contain broad

community representation, because the BQI focuses on elements of direct concern to users such as shellfish and swimming closures, and illnesses due to consumption of contaminated seafood. Citizens are likely to want to know if they can eat the fish, swim in the water, and walk along the beach without getting into tar, oil slicks, and unpleasant odors. One intriguing way to identify needed outcome indicators is to interview local people in a series of oral histories about what the estuary used to be like. This provides a baseline of past conditions and suggests conditions that should be tracked and perhaps included as long-range objectives.

The subcommittee should be responsible for undertaking the steps discussed above. It should also have responsibility for monitoring the index for at least two to three years to ascertain that it is providing sensible findings. Subsequently, the estuary program should provide for a periodic review of the index to determine whether changes are needed because of new environmental monitoring technology or newly emerging bay quality problems.

A major use of the index is to monitor trends over time. If the index is significantly changed, this can substantially degrade the ability to monitor trends. Changing the method of measurement of any components or adding or dropping components can substantially alter the time series. The estuary program subcommittee should then attempt adjustments to overlap the old and new time series. This might be done, for example, by continuing the old series for an additional year or two so that it overlaps with the new index, in order to permit reasonable insights into the overall time trend.

## Analyzing and Reporting BQI Information

Step 4, Selecting Sub-Indices, has already identified how the BQI can be designed to be of most utility to users of the information. Reporting an overall index for the whole estuary is likely to be of interest to elected officials and the public, but is not nearly as operationally useful to program personnel in government or the private sector as data on the sub-indices and the individual environmental indicators. [Exhibit 7.6](#) illustrates an attractive form of reporting geographical information. Such a map could also include data on sub-indices such as the condition of fish and support for desired uses. [Section 8](#) provides additional suggestions on analyzing and reporting BQI data.

## Limitations of the BQI

The BQI will not be able to cover all the environmental concerns that would ideally be included in the index. Furthermore, formulating the index will require extensive judgments based on sometimes arguable scientific information that is limited by our current technical abilities to monitor the environment. As stated earlier, the intent is to provide as good an indicator of overall bay quality as is currently financially and technically feasible for estuary programs.

As emphasized elsewhere in this report, BQI values also provide an indication of whether overall conditions are improving or worsening and to what extent, but the data will not indicate what has caused

these changes, nor what should be done to improve them. However, using the geographical or other sub-indices, the estuary program can attempt to link environmental outcomes to specific projects aimed at particular geographical areas of the bay or at particular sub-indices. In general, however, an estuary program will be undertaking many activities at one time which, taken together, affect overall bay quality. Extracting the effects of any one project is likely to require special in-depth evaluations. To alleviate this problem, personnel involved with the estuary program should provide, with each BQI report, the best information at their disposal that can help users of the report understand why the BQI values were at the calculated levels. Such explanatory information will aid users to better interpret the information, and will give estuary protection personnel the opportunity to discuss issues, activities, and problems that exist.

Environmental monitoring can be very expensive for a local program. Costs are affected by the number of parameters to be measured, the number of locations at which parameters are to be measured, frequency of sampling, and amount of precision sought (which can greatly affect the sample size needed). Estuary programs will need to concentrate scarce resources on those index components, locations, and times that represent key pressure points for the estuary.

Environmental monitoring is undertaken even in the absence of a BQI requirement or regular outcome monitoring, sometimes by the federal government or others in the scientific community. However, in general, federal monitoring does not provide the number of samples in the desired locations nor the frequencies likely to be needed in order to be useful to an estuary program for regular monitoring.

Some BQI data components such as counts of the extent of shellfish closures may require only a small amount of additional resources. Other data collection efforts, such as annual estimates of acreage of seagrasses, can require substantial additional resources and effort if not already being done on a regular basis.

To reduce cost, the estuary program can adjust data collection frequencies to reflect relative risk, stability, and importance of individual BQI components. For example, some components might be less frequently sampled in areas of the bay that have had few problems in recent years. Components that do not change rapidly can be measured less frequently than those that do. A useful BQI might contain data for some components that are older than ideally desirable. However, as long as environmental experts consider that data are reasonably appropriate, this should not prevent the use of those values in the BQI.

The process of developing the BQI is likely to be labor intensive because it relies on local technical experts to help develop the index and make the various judgments required. This effort will not necessarily require much additional out-of-pocket expenses unless, as done in Tampa Bay, the estuary program prefers to contract out parts of the BQI development. After the index has been developed, the time and resources required to transform the readings for each component into an overall BQI and sub-indices should be small especially if the procedure has been partly computerized. This applies even if the BQI is updated periodically throughout the year.

The ultimate test for determining the worth of the time and cost required is whether estuary protection

personnel are able to use the information to help them more effectively allocate resources for estuary protection and to communicate bay quality progress to the estuary's citizens.

**Notes, Section 7** 1. Andrew Robertson (NOAA) and Wayne Davis (EPA), 1993. The Selection and Use of Water Quality Indicators. *Working Paper or Proceedings of Water Environment Federation Conference*, Santa Clara, Ca., August.

2. Environmental monitoring data suggestions are provided in: *Monitoring Guidance for the National Estuary Program*, EPA 842-B-92-004, Washington, D.C.: Environmental Protection Agency (September 1992); Guidelines for the Preparation of the 1992 State Water Quality Assessments 305(b) Reports, Washington, D.C.: Office of Water, USEPA (August 1991); and Strategic Assessment of Florida's Environment: Final Review Indicator Manual, Tallahassee, Fla.: Florida Dept. of Environmental Protection (March 1993).

3. For a description of the regional coverage, frequency, and environmental indicator coverage of this major federal data collection program, see *EMAP Project Descriptions*, Environmental Protection Agency Office of Research and Development, Washington, D.C., EPA 620/R-93/009, September 1993.

4. For further information on the Tampa Bay BQI, see *Development of a Conceptual Design for Bay Quality Index for Tampa Bay, Florida*, St. Petersburg, Fla.: Coastal Environmental Incorporated, and the Tampa Bay National Estuary Program (December 1993).

5. For example, see *Compilation of Scopes of ASTM Standards Relating to Environmental Monitoring*, Philadelphia, Pa.: American Society for Testing and Materials (November 1993).

6. For other transformation scales developed by the Hillsborough County Environmental Protection Commission, see its report on Surface Water Quality, cited in [Exhibit 7.2](#). See Appendix A of that report for details on the procedure for transforming individual parameters into common units.

7. Ample precedence exists in the practice of establishing commonly understood categories to map technical numerical values. For example, the Environmental Protection Agency categorizes local air quality healthiness into the categories: hazardous, very unhealthful, unhealthful, moderate, and good. The categorization is based on levels of a number of pollutants that have been converted into a Pollutant Standard Index (PSI).

8. Florida's Department of Environmental Regulation has used a scale of good ( meets use ), fair ( partially meets use ), and poor ( does not meet use ) for assessing the quality of state waters. See Florida Department of Environmental Protection, 1992 Florida Water Quality Assessment, 305(b) Main Report, June 1992.

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# Measuring Progress of Estuary Programs

## Analyzing and Reporting Outcome Monitoring Information

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[Household and Boater Environmental Protection Behavior Outcomes](#)

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[Overall Summary of Estuary Protection Outcomes](#)

[Overall Constraints on Outcome Monitoring](#)

[Final Comment](#)

The information obtained from outcome monitoring procedures can be used by estuary program officials for many important purposes. Such information should help estuary program public and private officials:

- Identify where problems exist so that attention and resources can be directed to those areas;
- Identify the extent to which improved estuary outcomes have occurred after actions were undertaken by the estuary program;
- Provide information to organizations funding the estuary protection efforts, such as federal and state governments and local taxpayers, to identify the outcomes of those expenditures;
- Provide evidence for applying resources to activities where outcome information indicates that needs exist, and identify candidates for cutting back activities where desired outcomes have been completed and where activities have not achieved the intended results.
- Provide a baseline for long-range planning, against which future estuary protection progress can be assessed, and identify specific goals that should be included in the plan.

In the previous sections of this manual we provided suggestions on how to analyze and report the information obtained from each data-gathering procedure. Here we summarize, for each type of information, the major types of analysis and reporting likely to be most useful to local estuary program officials and provide suggestions on how to combine that information into a summary report. We also

identify the limitations of the procedures described in this manual.

# **Government Action Checklist - Outcomes (See Section 4)**

Below are suggestions for analyzing and reporting data that track government agency estuary protection progress.

1. For each category of government action (such as toxics reduction, storm water and agricultural runoff management) calculate and report the number and percentage of GAC items that all communities together have achieved, and that each community has achieved on its own. This will provide information on which categories of environmental protection appear to be doing well and which are not. This will allow encouragement and technical assistance to be provided to communities in categories of estuary protection activities for which assistance seems needed.
2. For each community, and for all assessed communities in aggregate, calculate and report the number and percentage of the checklist items that showed improvement from the previous assessment. Some estuary protection programs may also want to calculate the number and percentage of communities that improved on a certain number of the checklist items (such as three). This information indicates where progress has been made. The outcome information here and in #1 above identifies the latest level of achievement and progress made over the past year giving a more complete and fairer picture of each community's estuary protection status.
3. Calculate and report the number and percentage of those checklist items that each community and the estuary program itself had previously targeted for improvement and that showed improvement over the previous checklist assessment. This information should help communities measure the progress they themselves hoped to make.
4. Calculate and report the number and percentage of all checklist items that each assessed community has achieved (this is the total of #1 for each community, obtained by combining all categories of government action). Doing so provides an overall summary indicator of accomplishment for each community. Estuary program officials may choose to use such information to compare achievement among its communities, as has been done in Buzzards Bay. This is a useful strategy, if done constructively, and provides encouragement to communities to enhance their estuary protection. However, if, because of adverse media or inter-community relations, an antagonistic atmosphere exists, this comparative checklist information may aggravate those problems. In such cases, estuary program officials may find it better to play down the report card aspects of the presentation.
5. Tabulate and report (probably to a more limited audience) the number and percentage of communities that have achieved each item on the checklist. This information is more detailed than will be wanted by



most outside organizations and the public. However, it permits estuary program officials to focus on specific protection activities that warrant special attention.

6. Provide explanatory information along with the outcome data. This information should focus on those checklist items that the assessments indicate are particularly problematic or have shown significant improvements. Local government personnel responsible for the various checklist items should be encouraged to provide explanatory information on significant problems or improvements, and should be given the opportunity to do so before the report is disseminated externally. This will allow them to identify reasons and any actions they are taking to correct problems. This process is necessary for fairness and makes the outcome monitoring process less threatening, since local officials know they will have the opportunity to provide their side of the story. It also helps others interpret the major findings more easily.

7. Prepare a Summary of Survey Findings, as illustrated in [Exhibit 6.6](#). Analysts should highlight significant progress made over previous checklist assessments progress made both by individual communities and by the estuary program as a whole.

## **Business Environmental Protection Behavior Outcomes (See [Section 5](#))**

**Below are suggestions for analyzing and reporting data on businesses that estuary program officials are likely to find most useful.**

1. For each estuary protection question in the survey, tabulate and report the percentage of businesses that provided a response in each category. Also calculate and report the number and percentage for each category of business. As indicated in Section 5, businesses might be categorized by size, type, and location. These data will provide information to estuary program officials to help determine where future estuary protection efforts should be targeted. The format used in [Exhibit 6.5](#) for household surveys can also be used for tabulating data on questions included in the survey of businesses.

2. After repeat surveys have been conducted, calculate and report comparisons over time. The findings will indicate time trends and where improvements have occurred. This information will be particularly useful to assess the results of estuary program efforts to encourage or assist certain categories of businesses. It will provide estuary program officials with evidence on whether their efforts have led to

desired outcomes. The evidence will be stronger if changes in outcomes for assisted businesses are compared to those for unassisted businesses, as suggested in [Section 5](#).

3. Provide explanatory information along with the numerical data where relevant. Such information will provide estuary program officials with a better perspective on why the outcomes observed occurred. For example, if business activity significantly increased or decreased during the year, or the estuary protection program had assisted a particular industry to improve handling of toxic or hazardous materials and waste, this might explain improvement findings.

4. Prepare a Summary of Survey Findings as shown in [Exhibit 6.6](#). This information will be useful to public and private officials by enabling them to glean the major findings from each such survey of businesses without having to wade through extensive tables.

## **Household and Boater Environmental Protection Behavior Outcomes (See [Section 6](#))**

Below are suggestions for analyzing and reporting data on the estuary protection behavior of households and boaters.

1. For each estuary protection question in the survey, tabulate and report the percentage of respondents that provided a response in each category. These data should also be broken out by household (or boater) characteristics of importance, to help interpret the information and determine where future estuary protection efforts should be directed. For example, the data on each question might be tabulated for each community, by household size and composition, and by whether the households are renters or owners. For boater surveys, the docking location and type of boat would also likely be relevant. [Exhibit 6.5](#) illustrates one format for presenting the data on each survey question. Such reporting will identify the extent to which potential environmental problems are indeed problems and for which types of households. Such information will help determine what estuary protection efforts are most needed and how these efforts should be targeted.

2. Calculate and report the overall percentage of households that indicate having, say, two or more environmental problems. This is a summary indicator that should also be broken out by the household characteristics discussed directly above in item #1. This will help target types of households that have multiple estuary protection problem behaviors.

3. Calculate and report comparisons of findings from one year to the next. Findings from any one survey will be helpful in determining the current need and level of household (or boater) estuary protection behavior. But for tracking progress, repetitions of the same survey (with the same questions) are needed. As multiple surveys are undertaken, time trends will become evident. Changes in the findings from one year to the next should be of particular interest to estuary programs that have been conducting major



activity aimed at increasing household or boater estuary protection behavior. If activities in the past year have focused on particular household or boater behaviors, the report should highlight findings related to the targeted behaviors.

4. Provide relevant explanatory information to give a more in-depth perspective on the findings from the household or boater survey. For example, analysts may be aware that a particular community has undertaken a neighborhood assistance program. This might explain significant improvements in the household estuary protection behavior of households in that community.

5. Prepare a Summary of Survey Findings, as illustrated in [Exhibit 6.6](#). Analysts should identify the key findings from the latest survey, including trend information. They should, as appropriate, single out where particular types of households were especially deficient or had made substantial improvements in estuary protection behavior from previous surveys. This provides busy estuary program and community officials with a quick summary without having to pour through extensive tables.

## Bay Quality Index (See [Section 7](#))

In [Section 7](#) we described how to transform potentially overwhelming amounts of environmental monitoring data into more manageable and useful form by creating a BQI. Below we summarize ways to analyze and report BQI information.

1. Calculate and report the BQI for various portions of the estuary as well as for the estuary as a whole. The BQI lends itself to breakouts by geographical section of the estuary. This permits tabular presentations by estuary section as well as visual displays, as illustrated in Exhibit 7.6. Mapping displays can be particularly informative to officials and the public if the indices are transformed into easy-to-understand bay quality categories such as excellent, good, fair, or poor, as described in Section 7. This summary information enables readers to obtain a comprehensive picture of bay quality. It can help trigger, and gain support for, improvement efforts in parts of the bay found to be of low quality.

2. Break the overall index into sub-indices for various types of components including water quality, health of living resources, and the extent of bay support for desired uses such as swimming and commercial seafood collection.

3. Calculate and report comparisons of BQI findings from the current year to previous years. This will indicate both short- and long-term trends.

4. Provide back-up information that helps explain significant changes in the BQI from one period to another, or for any given period. This can be done by analyzing the quantitative data on the particular components of the index. For example, if nitrogen loadings or dissolved oxygen readings are the main cause for the index's improvement or worsening, this should be reported. The BQI is intended to be a summary measure that gives a comprehensive picture of bay quality. However, the back-up data on

individual environmental indicators need to be examined for their effects on the index values and to help guide future estuary protection actions.

5. Provide qualitative explanatory information with the BQI report. Likely sources of problems reflected by the index will be of major interest to users of the index information. For example, external events such as an unusual amount of rain or the start up of new industries should be identified along with the BQI data.

## Overall Summary of Estuary Protection Outcomes

In the preceding sections we have suggested ways to analyze the findings from individual data collection procedures. The estuary protection program will also likely want an overall summary, combining the information obtained from these procedures by:

- *Using a format such as that shown in [Exhibit 8.1](#).* Exhibit 8.1 identifies each key outcome indicator, its order (whether it is a first-, second-, third-, or fourth-order effect), and provides the latest and previous year's data for each indicator. Each estuary program needs to develop its own set of indicators as described in [Section 3](#) and illustrated in [Exhibit 3.3](#). In that exhibit we presented a summary set of outcome indicators for each category of estuary protection activity, preceded by a very short list of overall outcome indicators that can provide a summary. Exhibit 8.1 includes only the very short list. Such aggregated data, however, do not themselves provide information on where problems exist. To do that, estuary program officials will need to examine the more detailed information described earlier in this section.
- *Comparing the findings from the various outcome indicators against the goals identified in the estuary's long-range plan* (e.g., CCMP). Summarize the extent of progress that has been made toward these goals. Outcome monitoring information can be used to help track progress toward long-range goals. Indicate whether the goals, or the planned time schedule for achieving them, needs to be revised.
- *Preparing a Summary of Survey Findings that identifies for estuary program officials significant improvements or problems indicated by the latest data.* [Exhibit 6.6](#) illustrates such a report (in this case, based solely on household survey information). Explanatory information should be included for unusually high or low values. This summary should be drawn from the individual Summary of Survey Findings developed for each of the data collection procedures described in Sections [4](#), [5](#), [6](#), and [7](#). [The highlights should also include summary outcome data such as illustrated in Exhibit 8.1](#), and relevant explanatory information, as discussed earlier. The highlights should both:
  - Summarize the extent to which targets set by the estuary program have been achieved during the current reporting period; and
  - Compare the outcome information for the current reporting period to that for the previous period(s).Thus, estuary program and community officials will likely find the outcome information considerably more useful if the monitoring process provides the following information:
  - A Summary of Survey Findings developed by staff based on their best judgment of the most important findings for the reported period;
  - Explanatory information to supplement the outcome data, for the purpose of identifying factors

believed to have contributed significantly to the main findings;

- Comparison of current reporting-period outcomes to those of previous reporting periods;
- Comparison of actual outcomes to the targets set by estuary programs at the beginning of the year, such as those set by individual communities as part of the Government Action Checklist procedures.

## Overall Constraints on Outcome Monitoring

There are several limitations to the outcome monitoring process outlined in this manual. We discuss them in turn below.

### Lack of Causal Information

The data collection procedures described in this manual, like most data collected by estuary programs, do not tell what caused these outcomes. For example, the presence of improvement from one year to the next in the environmental protection behavior of assisted businesses does not prove that it was the program activities that caused those outcomes. Other factors could have brought about the observed improvements in outcomes.

Outcome data provide a scorecard but do not generally provide a sound basis for praising or blaming estuary protection activities. Outcome information is vital for understanding what has been happening and what progress is being made, and for helping to identify where future attention and resources are needed.

To obtain information on why the outcomes are as they are, or why changes over the last reporting period have occurred, estuary program personnel will need to conduct more in-depth examinations. These might be done by staff, but estuary program officials will usually need to rely on local experts and evaluations by local colleges or universities to identify causes for outcomes.

The estuary program might also undertake in-depth program evaluations that use a variety of statistical and analytical methods to attempt to identify the extent to which specific activities have caused measured outcomes. These studies, however, can be expensive, and are unlikely to be feasible unless state or federal resources are provided. If an estuary program has an outcome monitoring program, in-depth studies are easier and less expensive to do, because more of the data on outcomes will already have been collected.

### The Need for Periodic Outcome Information

The first run of the outcome monitoring procedures will provide data for one point in time that will also serve as baseline data for comparisons for future years. One year of information, however, will be of somewhat limited value in identifying trends, unless the estuary program has been fortunate enough to have prior-year data on the outcome indicators.

## **The Delayed Effects of Program Actions**

Some estuary protection actions cannot be expected to lead to quick, substantive changes in some desired outcomes. For example, major problems in the presence of toxins or excessive nitrogen may take years to correct, because a new sewage treatment plant may take many years before it can correct a major source of the pollution. The ability to clean up PCBs in the bay may also take years. Nevertheless, early outcome information is needed to alert estuary program officials and the public to the presence of problems so that protection actions can begin.

## **The Need for Quality Control**

This manual has not discussed quality control procedures for the outcome monitoring process. Clearly, each of the data collection procedures should be re-examined periodically (at least once every year or two) to ensure that the procedures are being conducted properly and provide reasonably accurate data.

## **Cost and Effort**

Establishing an outcome monitoring process can take considerable start-up effort. It requires estuary program staff time, time on the part of personnel from the various government agencies involved (to help select the items to include in the Government Action Checklist), and time on the part of many advisory groups representing citizens, technical experts, and special interests in the community.

Once established, the regular ongoing data collection can also require considerable effort. This will vary widely, depending on the various factors discussed in previous sections of this manual. Once the procedures become routine, the effort required should be reduced considerably.

## **Final Comment**

We hope that this manual is helpful to estuary programs throughout the country in designing their own outcome monitoring processes and in making the findings useful to estuary program officials for improving bay quality. We recognize that this manual does not cover all the many outcome indicators that are likely to be relevant to some estuaries. We know that implementing such a process is hard work and is not something that an estuary program can do overnight. It will minimally take a year to establish an outcome monitoring process, and probably two to three years before the process can be fully implemented. The procedures first need to be pilot tested. Therefore, time-trend data are not likely to be available until two or three years after the process has begun. Estuary protection, however, is a long-run proposition. To do it well requires continuous, long-term attention.

Ultimately, an outcome monitoring process needs to stand the test of cost-effectiveness. If the information is not used to help estuary program officials improve their work, or if it does not provide funders or the public with relevant information that they can understand and utilize, the results will not

be worth the costs.

Nevertheless, estuary program officials vitally need scorecard information that tells them the progress they are making in protecting the bay and where deficiencies lie. Estuary protection programs should make a full-scale effort to develop an outcome monitoring process that will be useful to public and private officials.

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# Measuring Progress of Estuary Programs

## Definitions

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An *Estuary* is a coastal area where fresh water from rivers and streams mixes with salt water from the ocean. Many bays, sounds, and lagoons along the coasts are estuaries. Portions of rivers and streams connected to estuaries are also considered part of the estuary. The land area from which fresh water drains into the estuary is its watershed and affects the health of the estuary.

An *Indicator* is a particular characteristic or reference marker used to measure whether an outcome is being achieved.

An *Outcome* is an action or occurrence that happens outside the estuary protection program but that is likely to have occurred at least in part because of an estuary protection activity.

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# Measuring Progress of Estuary Programs

## 3.3 Illustrative Outcome Indicators

Overall Summary Outcome Indicators

| INDICATOR  | UNIT OF MEASURE        | ORDER | SOURCE                                 |
|--|------------------------|-------|--|
| Governments scoring 75% success on the "Government Action Checklist" | Number of Governments  | 1     | Government Action (GAC) Survey         |
| Households with at least one problem behavior                        | Percent of Respondents | 1     | Household Survey                       |
| Boaters with at least one problem behavior                           | Percent of Respondents | 1     | Boater Survey                          |
| Businesses reporting reduction in hazardous waste discharged         | Number                 | 2     | Business Survey                        |
| Amounts of pollutants discharged                                     | Various Units          | 2     | Agency Report                          |
| Overall water quality  | Water Quality Index    | 3     | Combination of Water Quality Factors   |
| Overall bay quality  | Bay Quality Index      | 4     | Combination of Living Resource Factors |

Reducing Toxic Indicators

| INDICATOR | UNIT OF MEASURE | ORDER | SOURCE |
|-----------|-----------------|-------|--------|
|           |                 |       |        |

|   |   |     |                                       |
|---|---|-----|---------------------------------------|
| Household hazardous waste collection                              | Number of Towns, Number of Events, and Amount Collected | 1   | GAC Survey                            |
| Oil recycling programs  | Number of Towns   | 1   | GAC Survey                            |
| Integrated pest management programs                               | Number of Farms, Number of Acres                        | 1   | GAC Survey                            |
| Businesses participating in pollution prevention activities       | Number, Percentage                                      | 1   | Business Survey, Local Agency Records |
| Businesses Reporting Reducing their Generation of Hazardous Waste | Number, Percentage                                      | 1/2 | Business Survey                       |
| Outfalls with toxics exceeding NPDES permit                       | Number, Percentage                                      | 2   | Federal Data                          |
| Toxics substituted or eliminated                                  | Pounds  | 2   | State Data                            |
| Fishing closures due to toxics                                    | Acres   | 4   | State Data                            |
| PCB concentrations in sampled fish                                | Percent with Excess Concentrations                      | 4   | State Data                            |

### Preventing and Managing Oil Spills

| INDICATOR  | UNIT OF MEASURE         | ORDER | SOURCE      |
|--|-------------------------|-------|-------------|
| Municipalities with oil spill coordinators with defined responsibilities, job descriptions, and requisite training           | Number, Percentage      | 1     | GAC Survey  |
| Municipalities with developed protocols in place (e.g., mutual aid pacts) that are compatible with Coast Guard regional plan | Number, Percentage      | 1     | GAC Survey  |
| Municipalities with appropriate equipment  | Number, Percentage      | 1     | GAC Survey  |
| Mutual aid pact among towns  | Number of Towns covered | 1     | GAC Surveys |



|  |                    |     |   |
|--|--------------------|-----|---|
| Boatyards/marinas with oil containment and cleanup equipment on site and with an active response plan  | Number, Percentage | 1   | Boatyards and Marinas, GAC Survey                     |
| Regulations in place for appropriate fueling of vessels; enforcement of regulations  | Number             | 1   | GAC Survey  |
| Oil spills   | Number, Size       | 2/3 | Local, State, and Federal Records                     |
| Oil spills that are responded to effectively by following response plan (overall assessment of event by spill coordinator, harbormaster, state, or local programs) | Number, Size       | 2/3 | Expert Judgments from State and/or Federal Government |

#### Managing Sewage and Septage

| INDICATOR   | UNIT OF MEASURE      | ORDER | SOURCE          |
|---|----------------------|-------|-----------------|
| Nitrogen-loading limits added to NPDES permits                      | Number of Towns      | 1     | GAC Survey      |
| Businesses adopting pre-treatment and pollution prevention programs | Number of Businesses | 1     | Business Survey |

#### Overall Summary Outcome Indicators

| INDICATOR  | UNIT OF MEASURE                      | ORDER | SOURCE       |
|--|--------------------------------------|-------|--------------|
| Towns with program for licensing septage haulers                                 | Number of Towns                      | 1     | GAC Survey   |
| Days businesses did not meet NPDES limits and were in substantial non-compliance | Number of Days, Number of Businesses | 2     | Federal Data |
| Untreated sewage discharged directly into bay                                    | Gallons                              | 2     | State Data   |

#### Managing Stormwater and Agricultural Runoff

| INDICATOR | UNIT OF MEASURE | ORDER | SOURCE |
|-----------|-----------------|-------|--------|
|-----------|-----------------|-------|--------|

|   |                   |     |                      |
|---|-------------------|-----|----------------------|
| Remedial stormwater BMPS in place   | Number of Volumes | 1   | GAC Survey           |
| Educational measures for farmers developed to control agricultural runoff | Number of Towns   | 1   | GAC Survey           |
| Bylaw changes for new developments (subdivision regulations)              | Number of Towns   | 1   | Planning Boards      |
| Remediation of illegal septic tie-ins                                     | Number of Towns   | 1   | GAC Survey           |
| Sewer overflows   | Number, Volume    | 1/2 | Local Agency Records |

### Managing Boat-related Wastes

| INDICATOR  | UNIT OF MEASURE            | ORDER | SOURCE               |
|--|----------------------------|-------|----------------------|
| Identification of no-discharge areas             | Number of Towns            | 1     | GAC Survey           |
| Availability of pump-out facilities              | Number of Towns            | 1     | GAC Survey           |
| Usage rate of pump-outs                          | Number of Boats Using Them | 1/2   | Local Agency Records |
| Boaters who report using pump-outs regularly     | Percentage                 | 1     | Boater Survey        |
| Regulation of MSD chemical additives             | Number of Towns            | 1     | GAC Survey           |
| Enforcement actions taken for illegal discharges | Number of Towns            | 1     | GAC Survey           |
| Implementation of education program for boaters  | Number of Towns            | 1     | GAC Survey           |

### Managing Nitrogen

| INDICATOR                                   | UNIT OF MEASURE | ORDER | SOURCE     |
|---|-----------------|-------|------------|
| Nitrogen-loading standards adopted by towns | Number of Towns | 1     | GAC Survey |
| Use of BMPs by farmers                      | Number of Farms | 1     | GAC Survey |

|   |  |   |                          |
|---|--|---|--------------------------|
| Embayments exceeding nitrogen-loading standards | Number                                       | 3 | Environmental Monitoring |
| Excessive amounts of nitrogen                   | Number of Embayments with Excessive Readings | 3 | Environmental Monitoring |
| Amount of seagrass                              | Acreage                                      | 4 | State Data               |

#### Managing On-Site Septic Systems

| INDICATOR  | UNIT OF MEASURE                  | ORDER | SOURCE               |
|--|----------------------------------|-------|----------------------|
| Septic system regulations requiring inspection and upgrade prior to title transfer | Number of Towns                  | 1     | GAC Survey           |
| Noncomplying systems identified and remediated                                     | Number of Towns                  | 1     | GAC Survey           |
| Innovative/alternative systems installed   | Number of Such Systems           | 1     | Local Agency Records |
| Septic systems "x" ft. from coastal area   | Number of Systems                | 1     | Local Agency Records |
| Incidence of identified overflows  | Number of Systems with Overflows | 2     | Local Agency Records |

#### Assessing Shellfish/Finfish Resources

| INDICATOR                               | UNIT OF MEASURE                             | ORDER | SOURCE                         |
|---|---|-------|--------------------------------|
| Shellfishing areas closed               | Acres                                       | 4     | Environmental Monitoring       |
| Shellfish/finfish kills                 | Number, Size                                | 4     | State and Local Agency Records |
| Incidence of Diseased Shellfish/Finfish | Percentage of Species, Number of Occurences | 4     | State Data                     |

- This exhibit is a modified version of tables developed by the Buzzards Bay Project (Massachusetts).
- "Order" refers to the four orders. Order 1 = indicator of behavior; 2 = indicator of amount of pollutants discharged into the bay; 3 = indicator of bay water quality; 4 = indicator of the health of bay living resources.
- Item included in Government Action Checklist



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# Measuring Progress of Estuary Programs

## 4.2 Sample Categorizations of GAC Indicators

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### Buzzards Bay Categories

- Nitrogen Action Plan,
- Protecting and Enhancing Shellfish Resources,
- Controlling Stormwater Runoff,
- Managing Sewage From Boats,
- Managing On-Site Wastewater Disposal Systems,
- Preventing Oil Pollution,
- Protecting Wetlands and Coastal Habitat,
- Planning for a Shifting Shoreline,
- Managing Sewage Treatment Facilities,
- Reducing Toxic Pollution,
- Conducting Pollution Remediation Projects in New Bedford.

### Tampa Bay Categories

- Water Quality,
- Land Use,
- Septic Systems,
- Municipal Waste,
- Hazardous Materials and Hazardous Wastes,
- Stormwater,
- Conservation Measures,
- Boater Use and Boater Discharges,
- Oil Pollution and Emergency Response,
- Agricultural Industry,
- Other Industry,
- Shellfishing,

- Public Information/Technical Assistance,
- Intergovernmental Coordination,
- Miscellaneous.



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# Measuring Progress of Estuary Programs

## 5.1 Illustrative Industry Questionnaire (Based on one tested in New Bedford, Mass.)

|  |     |    |
|--|-----|----|
| 1. Does your firm have a current toxic material / waste reduction plan?                                      | Yes | No |
| 2. Does your firm have specific toxic material / waste reduction targets?                                    | Yes | No |
| 3. Do you believe that you and your firm have sufficient and clear information about the following: , ,      |     |    |
| a. Toxic waste requirements?   | Yes | No |
| b. Technical information on the toxic materials that your firm uses?   | Yes | No |
| If yes to either (a) or (b), what information do you need?<br>_____ ,  |     |    |
| 4. In the past 12 months have you done any of the following:   |     |    |
| a. Sent personnel to workshops or training sessions that contained a significant toxins reduction component? | Yes | No |
| If yes, approximately how many employee-days were spent?<br>_____ ,  |     |    |
| b. Organized employee teams to work on toxins / hazardous waste reduction?                                   | Yes | No |
| c. Conducted an in-plant audit or assessment that contained a significant toxins eduction component?         | Yes | No |
| If yes, who did the audit/assessment (check all that apply):   |     |    |
| Your own staff   | Yes | No |
| A consultant paid by your company  | Yes | No |
| State personnel  | Yes | No |
| Others (please specify)<br>_____ ,   |     |    |
| d. Initiated a recovery and reuse program for any item containing toxic / hazardous material?                | Yes | No |
| If yes, what toxic/hazardous material?<br>_____ ,  |     |    |

|   |      |      |
|---|------|------|
| e. Eliminated or replaced the use of any item that contained toxic/hazardous material?  | Yes  | No   |
| f. Changed the way you handle toxic hazardous wastes (such as by a pre-treatment or isposal method) so as to reduce the amount of waste discharged into the water and air?  | Yes  | No   |
| 5. Overall, have any of the above activities, or similar ones that you have used, actually enabled you over the past 12 months to actively reduce your company's:   |      |      |
| a. Use of toxic/hazardous materials?  | Yes  | No   |
| b. Amount of toxic/hazardous materials discharged into the water and air?   | Yes  | No   |
| 6. How have these toxic / hazardous waste reduction strategies over the past 12 months affected your company's overall costs per unit of product (considering both operating and capital cost)? Please check one: |      |      |
| Increased overall cost per unit of product produced   | .... | .... |
| Decreased overall cost per unit of product produced   | .... | .... |
| Neither   | .... | .... |
| Don't know  | .... | .... |
| 7. What training and technical assistance, if any, would you like for your firm?<br>_____<br>_____  |      |      |



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# Measuring Progress of Estuary Programs

## 6.2 Illustrative List of Potential Household and Boater Behavior Problems to Be Covered in Surveys

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- Handling of fertilizers;
- Handling of pesticides and herbicides;
- Handling of used oil, paint, and household chemicals;
- Lawn-watering;
- Handling of waste while boating;
- Handling of pet wastes;
- Type of mulch used;
- Cleaning of on-site septic systems;
- Stormwater runoff control;
- Water use.





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# Measuring Progress of Estuary Programs

## 6.5 Illustrative Report Format for Household Survey Responses (Hypothetical Data)

Percentage of respondents that reported disposal, in the past 12 months, of motor oil, paints, or chemicals at (a) county collection sites; (b) local service stations; (c) into sewer or storm drains.

|                             | <b>Number of Respondents</b> | <b>County Collection Sites</b> | <b>Local Service Stations</b> | <b>Sewer or Storm Drains</b> |
|-----------------------------|------------------------------|--------------------------------|-------------------------------|------------------------------|
| Total Number of Respondents | + 200                        | 90 +                           | 70 +                          | approx. 40                   |
| Percentage of Total         | + + 100%                     | 45%                            | 35%                           | 20%                          |
| County A                    | + 60                         | 67%                            | 25%                           | + 8%                         |
| County B                    | + 75                         | 27%                            | 53%                           | 20%                          |
| County C                    | + 65                         | 31%                            | 38%                           | 31%                          |
| One-Person Household        | + 35                         | 43%                            | 43%                           | 14%                          |
| Two-Person Household        | + 65                         | 38%                            | 39%                           | 23%                          |
| Three-Person Household      | 100                          | 50%                            | 30%                           | 20%                          |
| Owners                      | 120                          | 67%                            | 25%                           | + 8%                         |
| Renters                     | + 80                         | 13%                            | 50%                           | 37%                          |



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# Measuring Progress of Estuary Programs

## 6.6 Summary of Survey Findings: Tampa Bay Household Environment Survey, 1992/1993

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- Forty-two percent either do not have or do not know if they have water flow saving devices.
- Forty-five percent do not have a displacement device in their toilet; another 11 percent do not know if they do or not.
- Twenty-five percent of those surveyed who had disposed of oil, paint, or chemicals in the past 12 months reported disposing of them in their sewer or outside storm drain.
- Seventy-two percent are separating their trash for recycling; 25 percent are not.
- Twenty-four percent of dog owners never pick up their animal wastes; 14 percent do it "sometimes."
- While only 9 percent do not use slow-release fertilizers, 30 percent do not know if they do or not.
- Forty-eight percent use pesticides to control yard pests; 50 percent use pruning.
- Seventy-three percent have mostly, or some, native or drought resistant plants and trees; 17 percent are not sure if they do or not.
- Regarding new foliage planted, 21 percent said they are not drought resistant varieties; another 29 percent said they didn't know if they were or not.
- Twenty-six percent said they do not group plants according to fertilizer/watering needs; another 31 percent did not know if they did or not.
- Although only 7 percent have septic systems, of these, 67 percent pump out residues later than the recommended 3 to 5 years. Additionally, 67 percent use cleaning compounds and 34 percent use a garbage disposal.



Note: This information is provided for reference purposes only. Although the information provided here was accurate and current when first created, it is now outdated.

# Measuring Progress of Estuary Programs

## 7.1 Examples of Components for a Bay Quality Index Focused on Condition of Living Resources (A Fourth-Order Outcome)

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- Extent of shellfish bed closures or restricted use/consumption advisories;
- Extent of beaches closed to bathing or having other restrictions due to unnatural causes;
- Acreage of seagrasses;
- Number of fish kills;
- Fish populations;
- Populations of selected mammals and birds;
- Extent of algae blooms;
- Extent of offensive noxious odors;
- Prevalence of fish abnormalities due to unnatural causes, based on tissue samples;
- Number of cases of human illness due to consumption of contaminated seafood;
- Citizen ratings of estuary attractiveness.



Note: This information is provided for reference purposes only. Although the information provided here was accurate and current when first created, it is now outdated.

# Measuring Progress of Estuary Programs

## 7.2 Example of BQI Components and Their Weights

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| PARAMETER                                 | WEIGHT |
|---|--------|
| Percentage of Saturation Dissolved Oxygen | .212   |
| Chlorophyll "a"                           | .167   |
| Total Coliform                            | .167   |
| Effective Light Penetration               | .111   |
| Total Phosphorus                          | .111   |
| Total Kjeldahl Nitrogen                   | .111   |
| Biochemical Oxygen Demand                 | .111   |
| Sum of Parameter Weights                  | 1.000  |

Source: Richard Boler., ed. 1992. "Surface Water Quality, Hillsborough County, Florida, 1990-1991." Tampa,, Fla.: Hillsborough County Environmental Protection Commission (September), p. A-2.